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THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

BRICK AND MARBLE IN THE MIDDLE AGES.

G. EDMUND STREET.

CHAPTER VIII.

"Break, break, break,
On thy cold, gray stones, O sea!
But the tender grace of a day that is dead
Will never come back to me."

Tennyson.

PADUA AND VENICE RAILWAY — VENICE: PIAZZA AND CHURCH OF ST. MARK — TORCELLO — THE LAGOON — MURANO — STA. MARIA DEI FRARI — SS. GIOVANNI E PAOLO — STA. MARIA DELL' ORTO — OTHER CHURCHES — DOMESTIC ARCHITECTURE — FONDACO DE' TURCHI — OTHER BYZANTINE PALACES — THE DUCAL PALACE — FOSCARI PALACE — CA' D' ORO — OTHER GOTHIC PALACES — BALCONIES — VENETIAN ARCHITECTURE — A FESTIVAL — PAINTINGS.

LITTLE is to be seen as one leaves Padua to distinguish the city at all vividly save the Oriental looking cupolas of Sant' Antonio, and the great roof of the Sala della Ragione, looking like the inverted hull of some great ship, with its convex sides towering up above the otherwise not remarkable-looking city.

And now our destination was Venice, and anxiously we looked out ever and anon, impatient, long before the time, to see the tall outline of St. Mark's campanile against the horizon. The view was too contracted to be really beautiful; on each side of the railway rank and luxuriant hedges of acacia sprouted their tall branches above the carriages, and beyond them might be seen plantations of maize, flax, and other crops, all remarkable for their prodigious growth and size, and watered by countless small canals, and here and there with turgid, muddy-looking streams rushing on from the mountains to discharge themselves into the Adriatic, and gliding between great artificial banks, which gave them the appearance rather of large canals than rivers. Nothing breaks the dead monotony of the scene, for it is misty, and the Tyrolese Alps, which ought to show their jagged peaks to the north, are invisible. The stations follow each other in quick succession, and at each stand some diligence or carriage whose ingrained panoply of white dust, added to that which rises here and there white and cloud-like in the dry glare of the Italian sun, which beams overhead, makes one feel grateful that — however unpoetical such a mode of approach may be — a railroad carries us to Venice. Nor is such a country as this along which one passes, from Padua to Venice, without its moral. I suppose there is nothing more certain than that, ordinarily, the appreciation of high art, and success in its practice, have never been so marked in countries whose natural features are lovely as in those in which the devoutest student of nature's beauties can see nothing to admire or love. So Venice, surrounded by waters, and then by a country which would be entirely tame and uninteresting were it not for the exquisite distant views of the Friulan Alps, fell back on her own resources, and provided herself with that substitute for the loveliness of nature which, alone of man's works, the loveliness of beautiful art can be. And perhaps it is better for the traveller that no interest should be felt save in the end of the journey, where the journey has so brave an end!

At last, however, the broad, watery level of the Lagoon is reached; Venice rises out of the water at a distance of some two miles; and then, across an almost endless bridge, the railway takes us into the outskirts of the city. A confused idea of steeples and domes is all that is obtained, and one finds one's self going through that most painful of processes to an excitable man, the usual examination of luggage. At last, however, we are outside the station, the Grand Canal lies before us, and we are vehemently urged to get at once into an omnibus-gondola. But no, this is too absurd a bathos for our first act on entering Venice, and we step, therefore, into a private gondola, and, propelled rapidly and lightly over the still, unruffled water, sink at once into that dreamy kind of happiness which, of all conveyances in the world, the gondola is best calculated to encourage. A short reach of the Grand Canal is soon passed, and then, with the picturesque cry of warning, "*Ah, stal i!*" we turn sharply into a narrow canal to the right, and, shooting down the tortuous street of water, presently cross the Grand Canal again, midway between the Rialto and the Foscari Palace, dive into another canal still narrower than the former, and at last, after frequent glimpses of mediæval houses and palaces, find ourselves safely housed at our hotel, close to the Grand Canal, and within two or three minutes' walk of the Piazza San Marco.

We stopped but a short time here, so impatient were we to obtain our first glimpse of the church and palace of St. Mark, to which Venice owes much of her fame. We passed along some narrow, winding alleys, lined on either side with open shops, on the counters of which lie exposed for sale not over-dainty looking edibles, and in whose dim interiors little light of day seems ever to enter to help the busy workmen who may always be seen there plying their trade; and then, going under an archway crowded with busy folk in rather noisy consultation, we found ourselves, in four or five minutes, standing under the arcade at the upper end of the great Piazza San Marco. Long lines of regular architecture arcaded below, heavy with cornices, and elaborated windows above, carry the eye not unpleasantly down to the lower end of the piazza, at the right-hand angle of which towers up into the air a vast campanile, simple and unbroken in its outline, without visible window or any buttress-like projection, until its upper stage, where it has a very simple, open, arcaded belfry, capped with a pyramidal roof; and then across nearly the whole width of the piazza, and partly concealed by the curiously irregular position of its campanile, stretches the low, singular, and Eastern-looking church of St. Mark. Before it rise the masts from which of yore hung waving in the wind the banners of the old Venetian state, and crowds of pigeons, fed here by civic liberality, cover the pavement with their pleasant fluttering presence. The charm of the west front is certainly most indescribable, and I confess to feeling a doubt as I looked at it whether it was not more akin to some fairy-like vision, such as one might see in dreams, than to any real and substantial erection of stone and mortar; for, indeed, to a mind educated in and accustomed to the traditions of Northern Gothic, there is something so very *outré* in the whole idea, something

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so startling in its novelty, that it is hard at first to know whether to admire or not. It is far from imposing in size, but yet, as it is looked at more and more carefully, it grows much and rapidly on one's love, and at last imprints itself on the mind as a real work of art of a very beautiful and unusual kind, wrought out with an abundance of beautiful detail, but in such a way as to prevent its being possible that it could ever be absolutely reproduced or taken as a model.

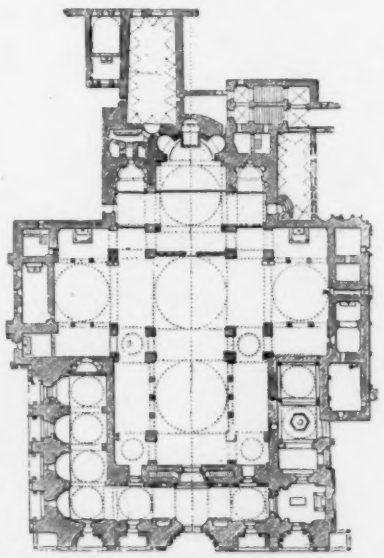
As you pace down the broad level space of the Piazza the feeling of the strangeness of the whole scene increases. There are of course no horses, and no vehicles of any kind; it is a large square in which all the space is footpath, and on which, in addition to the many men who pace it rapidly with busy brow, or idly lounge whilst enjoying the weather and the place, hundreds of pigeons are constantly fluttering or walking about in quiet confidence, sure that they will not be molested by any one. And then, as one draws near to the church, it is easy to understand rather better than at first in what its real charm lies; this is, no doubt, before anything else, in its beautiful color; the whole front is shafted to a greater extent than almost any building I know, the shafts all rather heavy, but of marble of the richest kind; the groining of the seven entrance arches is filled with mosaics, and the walls are encrusted everywhere with marble. Instead of ordinary gables masking the roof, the front is finished with great ogee gables most extravagantly crocketed, and obviously a modern alteration of the orignal Romanesque finish; behind these a cluster of fourteenth-century cupolas completes the view. Of the seven arches which compose the façade, four have doorways; the outer arches on either side are very narrow, and answer in width to the kind of cloister which masks the church on the south, west, and north sides; and the central arch is much wider and loftier than the others, rising, indeed, so high as to break through the line of balustrading which runs across the front just above the other arches.

Within this central arch is a grand doorway, the stilted semicircular arch of which is of three orders, the central plain, the others covered with carvings. The piers supporting the main arches have tiers of shafts in two heights, the lower tier corresponding in height with those of the doors pierced within the arches, and the others, which are smaller in diameter, and more numerous than those which support them, rising to the springing-line of the main arches. The side doorways have very Eastern-looking arches, the semicircular line being carried on nearly to the centre, and then turned up into an ogee. These and some other portions, as *e. g.*, the windows over two of the doors, and the pinnacles between the gables, belong to the fourteenth century, whilst the finish of the gables themselves — great ogee crocketed gables with figures at the apex of each — is probably of the fifteenth century. All these archways open into the cloister, or narthex already mentioned. Here, where the roofs still glow with the most precious early mosaics, and the walls with marble, either used as inlays or for shafts, one gets a first and not unworthy hint of the beauty which awaits one in the interior.

And then, on entering the nave, the deep tones of an organ are heard reverberating through the old building; many people kneel devoutly at their prayers around us; the hot glare of the sun has gone, and in its place a cool, quiet, dim light reveals the whole magnificence of the design. It is quite in vain to describe this in formal architectural terms. The color is so magnificent that one troubles one's self but little about the architecture, and thinks only of gazing upon the expanse of gold and deep, richly tinted mosaic, all harmonized together into one glorious whole. The mosaics commence throughout the church at the level of the crown of the main arch dividing the nave from the aisles, and are continued up the remainder of the wall and into the domes; even the angles or arrises of the walls and arches are covered with gold mosaic; so that all architectural lines of moulding are entirely lost, and nothing but a soft, swelling, and undulating sea of color is perceived. There is nothing violent or garish in all this profuse decoration. The gold mosaic, used as it always is in early works, set irregularly in, and surrounded by a white line or joint of plaster, is never conspicuously bright; the drawing of the figures and subjects may be criticised, but at any rate it is always direct, simple, and intelligible, and the colors of the draperies bright and harmonious, whilst the arcading and wall-lining which fills the lower part of the walls is all of marble, which has now a rich, warm, but quiet tint, singularly suitable as a base to the more gorgeous coloring of the upper part of the walls and domes.

Altogether this is a church beyond most others suggestive of worship. Other churches sometimes suggest the same feeling, either by enormous size or vast height. At Köln or Milan man feels so small and so contemptible in comparison with the vastness of his own work that he is subdued in spite of himself. In countless other great Gothic minsters the same feeling is produced. But at St. Mark's it is produced in an intensified degree, and by a building the scale of which is in every way small, if not almost insignificant. There is no long vista of arches, no complicated perspective, and no vast height to awe the beholder, yet the mystery of color does for it even more than the mystery of size does for Köln or Beauvais, Milan, Toledo, or Bourges. It is, therefore, emphatically a church for worship, one in which even the most careless treads with hushed footstep and bated breath, and where, in spite of crowds, an awful silence seems always to reign supreme save when it is broken by the religious sound of the services of the church.

The ground plan is no doubt known to most of my readers. It is a typical example of the Greek or Eastern church as distinguished from the Romanesque, a cross whose arms are not far from equal, covered by a series of cupolas, one in the centre, one to each of the three eastern arms, and two to the western, with aisles to the nave and choir, and a cloister round the north, west, and south sides of the nave, of which the two former are the porches, and the latter the baptistery of the church.[1]



GROUND PLAN, S. MARK, VENICE.

Under the eastern limb of the cross is a crypt, which has in recent years been opened and drained, and is now always open to inspection. This is divided under the choir into five aisles in width by a multitude of small shafts carrying quadripartite vaults, and in the centre of which, just under the choir altar, is the shrine of St. Mark. Another apse is formed under the south aisle of the choir, and under the north aisle is a corresponding crypt, save that there is no apse to it. Much modernized as this has been in the course of repair, and entirely devoid of all color or decoration as it is, it is still full of character, and adds largely to the interest of the church.

(*To be continued.*)

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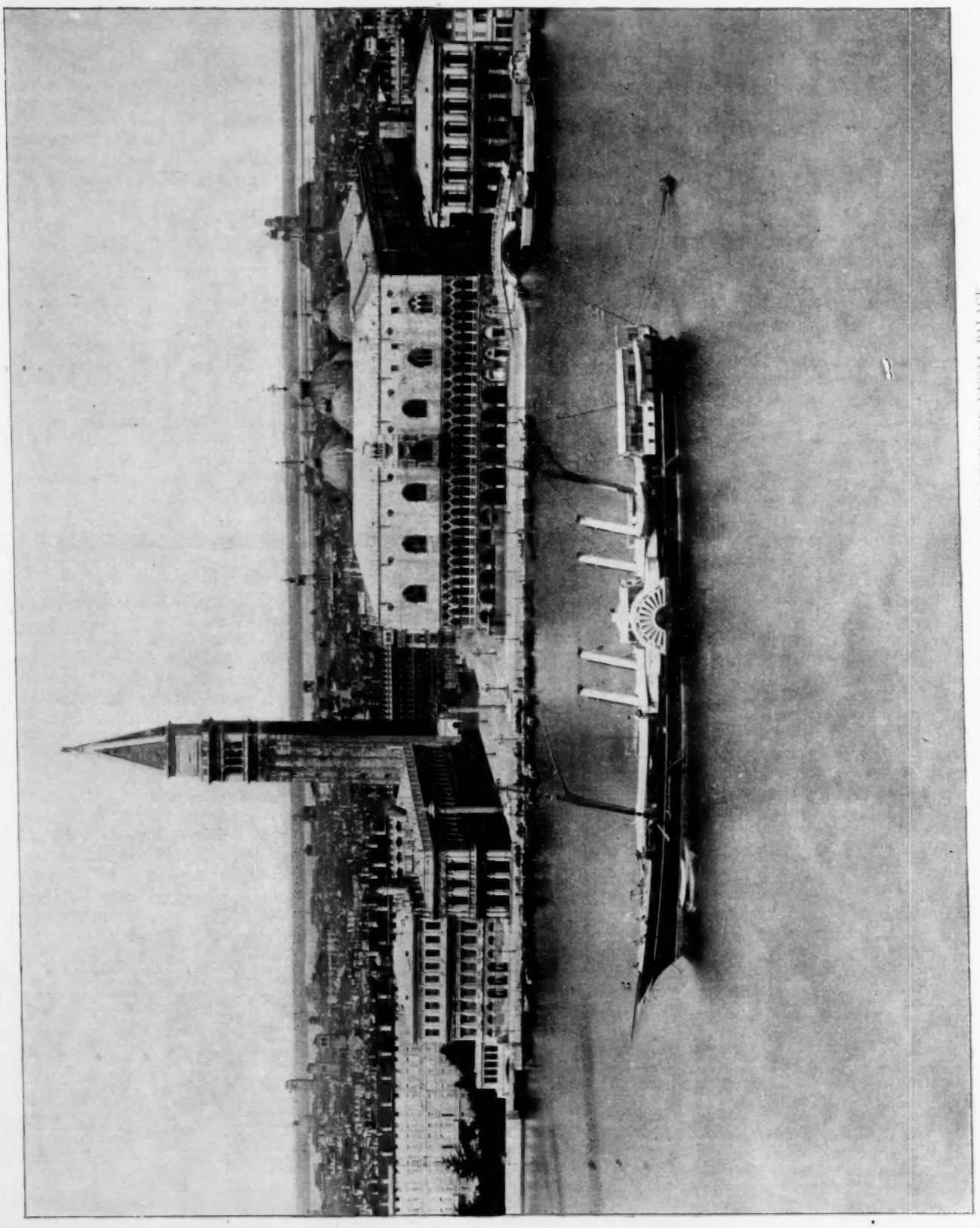
[1] The dimensions are worth giving to show how little this church owes to mere size. It is 245 feet long, 201 feet across the transept, and 170 feet across the west front. The height of the central cupola is 90 feet, and that of the west front, 72 feet.



VIEW OF THE PIAZZA S. MARCO, VENICE, SHOWING CAMPANILE AND DUCAL PALACE.
SUPPLEMENTARY ILLUSTRATION TO "BRICK AND MARBLE IN THE MIDDLE AGES."

THE ART OF BUILDING AMONG THE ROMANS.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

CHAPTER II. — Continued.

II. VAULTS WITH ARMATURES OF BRICKS LAID FLAT.

(*Continued.*)

THE ancients, in building armatures of flat-laid bricks, had a double purpose: first, to give the rubble a continuous and solid support; and, second, to obtain a strong bond between it and the armature. We have seen how they attained this in two celebrated monuments, — Hadrian's Villa and the Baths of Caracalla, — but the type of armature used in these colossal vaults was susceptible to much simplification for ordinary use. The advantages it presented could be obtained at a smaller cost, and what we now have to study are the modifications made by the Romans in order to render the system more economical of labor or of materials.

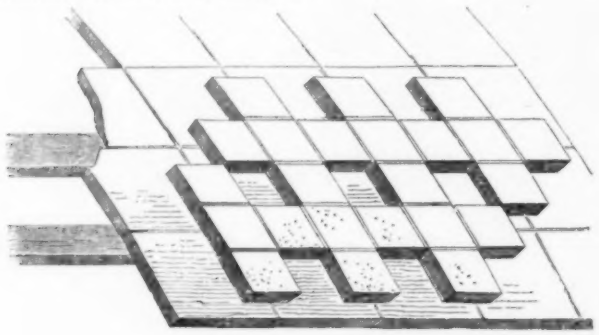


Fig. 32.

The type which differs the least from the two preceding examples is this in Fig. 32. The first layer was continuous, but the second was reduced to the bricks covering the joints of the lower bed, a simplification which was adopted in some of the rooms of the Palace of the Cæsars, and, if one may judge by the imprints, the armatures of the vaults of the Sette Sale, the reservoir near the Baths of Titus (Plate IV., Fig. 4), were much the same. The principal advantage of this arrangement of the second layer was that it required a smaller number of bricks, and was, at the same time, a means of establishing a strong bond between the rubble and the armature.

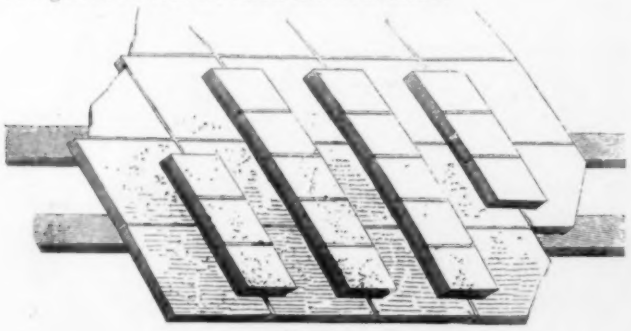


Fig. 33.

But the ancient builders did not stop here; in place of covering all the joints of the first layer, they contented themselves with placing bricks along the joints perpendicular to the axis of the vault, so that the armature consisted of a continuous layer of bricks re-enforced by ridges of smaller bricks, which, in the opinion of the Roman architects, served both to cover the joints and as ribs. This combination is to be found in many of the tombs of the Appian Way, and I give in Plate IV. (Fig. 3) the details of the vault of one of them, which is in a remarkably good condition; the bricks in the first layer are forty-five centimeters (one by one half foot) on a side, while those which cover the joints are only twenty-two centimeters. The mortar which lay in the joints has been washed away in the course of time, so that it is difficult to find traces of it, but one can easily find them in the so-called Villa of the Quintilii, which stands at the left of the Appian Way, not far from the tomb just mentioned. In the other monuments along the same road, the idea of using the second layer of bricks purely and simply to protect joints is expressed still more clearly and decidedly. Here the bricks of the second layer no longer form continuous zones, but are isolated, and are placed only at the angle common to four bricks, where the effects of a shock or of excessive pressure would be most disastrous.

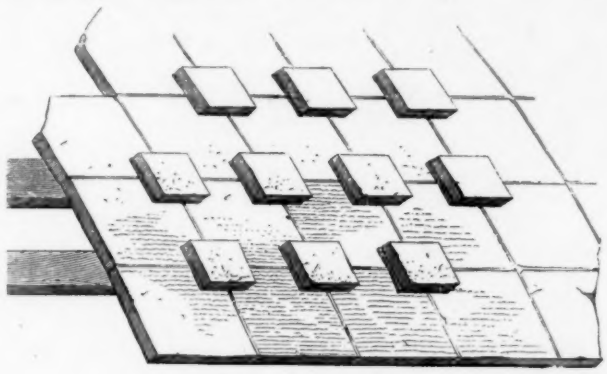


Fig. 34.

In order to be more economical, it was necessary to suppress the second layer entirely. The Romans took this last step on the way of simplification, and came to the construction of vaults on one layer of bricks alone; but the cases where the armatures are so reduced are relatively rare, and I was able to find but a single barrel vault where this elementary arrangement was well marked. This was in the Circus of Maximus (Plate IV., Fig. 1), outside of the gate of St. Sebastian, where all the vaults which carry the tiers of seats are built on a single layers of large bricks.

The use of armatures of flat-laid bricks in ancient vaults was very general; we shall meet them in vaults of the most complex forms as well as in barrel vaults; we shall see them indifferently used for the vastest halls, like those of the Baths of Carcacalla and for the narrowest galleries of the smallest aqueducts. In the last case they were often reduced, as in numerous galleries of the aqueducts opening into the arena of the Coliseum (Fig. 35), to two bricks about sixty centimeters square leaning against each other, and sometimes, as in the detail in Plate XIII., to a simple, single, horizontal brick.

Moreover, these armatures of flat-laid bricks were used for supporting not only vaults composed of horizontal courses of small stones and mortar. It often happened that the Romans built isolated brick arches with radiating joints, and it is to be remarked that they were invariably built on this system of armatures.

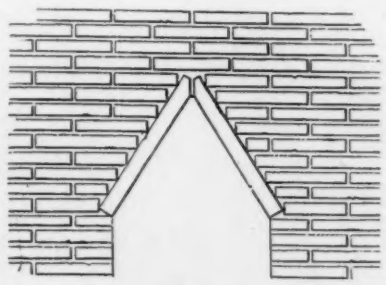


Fig. 35.

I may cite as examples of isolated arches with radiating joints built in this manner the portico of an amphitheatre near the church of Santa Croce, in Gerusalemme, and an arch from the Baths of Caracalla. (Fig. 36.)

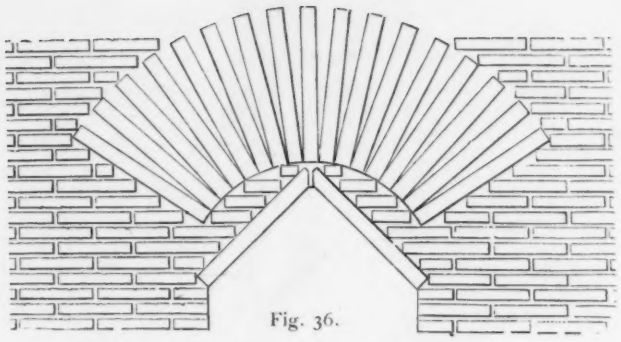


Fig. 36.

In concluding, I must call attention to the four great vaults which form, as it were, the side aisles of the immense hall at the centre of the Baths of Caracalla. In the entire edifice, and, I might add, among the great vaults of the Roman monuments that I examined, these barrel vaults alone have converging joints. Their masonry is composed of alternate layers of large bricks and tiles united by mortar. I give in Plate V. a view of one of these vaults, and it may be seen that this material with converging joints, as well as the rough, stratified masonry of the other vaults, rests on a double shell, in every detail, even to the headers, like those we have above described.

One can judge, from these many examples, how general was the use of these armatures in the ancient vaults; and their use, formerly so widespread, has not been entirely abandoned by the Italian builders. More than once have I watched them laid in the same country where, two thousand years ago, they were used with a success to which the Roman ruins still testify. They are yet very frequently employed in Rome itself, and the cloister-vaults which decorate the palaces of the modern city are, for the greater part, constructed with flat-laid bricks, like the vaults of the Baths of Caracalla, the intrados being ordinarily formed of a single layer of brick, and the rest being of the roughest rubble.

Tradition has, however, slightly modified the relative importance of the armatare and of the body of the vaults. Formerly the Romans considered the brick armature only as an auxiliary support for the rubble, and the rubble as the real vault, as the only part on which the architect could rely for the solidity and durability of his works. To-day, reversing the old opinion, it is the curved lining which is considered as the essential element, the active part of the vault. And sometimes this change of view is so marked in modern vaults that the rubble is reduced to a filling near the springing. Only the flanks are backed with rough masonry, and the parts near the summit are simply covered with broken stone. The Italian workmen

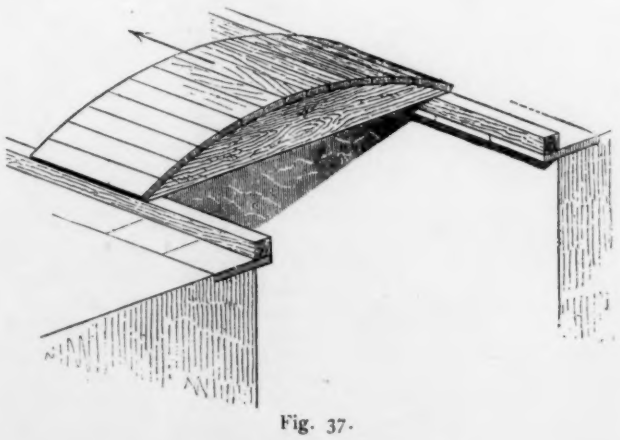


Fig. 37.

call this class of work "*volta alla volterrana*," and sometimes by the expressive name of "*volta a foglio*."

These vaults are seldom used in France in our days; yet their employment was frequent during the last century, and the details which Blondel gives of them are worthy of being recalled here (see *Cours d'Architecture*, t. VI., chap. II.). Flat vaults (for such they were called) were suddenly introduced into French architecture about the beginning of the eighteenth century, but in adopting them the architects were only renewing the tradition of the methods of the masons of Roussillon, preserved from a far distant past. And for an immemorial time the workmen had proceeded in the following manner: Joists were laid along the walls of the hall to be vaulted (Fig. 37), and on these was placed a movable centre about two and one half feet wide; on this were laid two layers of brick which were set in and bound together by mortar, exactly as in Italy, and exactly as among the Romans themselves; when one zone was finished the centre was pushed along the joists and a second zone laid, and so on. Then the thin vault thus built was strengthened with a filling which, though in a more modest form, corresponded with the masses of rubble in the ancient vaults.

The construction, as can be seen, was entirely in the spirit of Roman methods; the countries where it was in use adjoined the colonies of Provence, so it is probable that the method itself was a legacy of Rome. Be this as it may, the analogy is certainly remarkable, and it is not unimportant to find our explanations confirmed by a description of a still recent system of construction which agrees in every detail with the conjectures suggested by an examination of the Roman ruins alone.

GROINED VAULTS.

The questions so far taken up have been those relating to barrel-vaults. In passing to the study of groined vaults, it is my desire to mark the characteristics given to them by the Romans, to present clearly the methods of their construction, and to show, by examples, how the ideas I have been developing apply equally to these forms.

It is known, in a general way, that the ancients avoided penetrations; in the amphitheatres of Arles and of Nimes, where the circling corridors and the radiating passages cross each other in all directions, there is not a single instance of an intersecting vault; only a few intersections of unimportant barrel-vaults can be found in the arena of Verona; and before the ruins of the Coliseum one is astonished at the small number of penetrations involved by the continuous crossing of its innumerable galleries. To avoid penetrations, the Romans raised the springing of the vault of one gallery above the crowning of the vaults which it crossed; but while this solution presented no difficulty where it was applicable, a lack of height often made it impossible, and made the use of intersecting vaults unavoidable.

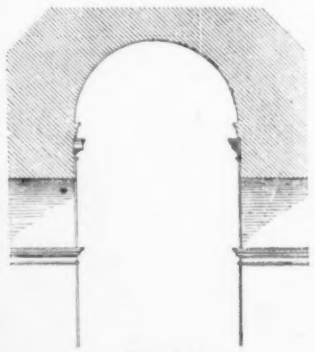


Fig. 38.

When the Romans had to vault, as was frequently the case, halls formed of a central nave flanked by two secondary ones, intersecting vaults were naturally used. In order to light the middle nave, there were only two possible methods, either to raise this vault high enough to obtain light through openings below the springing, or to make penetrations in the vault itself. The Romans ordinarily chose the second course, and it was in it that the groined vaults covering the great nave of the Basilica of Constantine (Plate III.) had their origin. It is for the same reason that groined vaults are to be found in the principal halls of the Baths of Caracalla (Plate V.), and in that most admirably preserved hall, which, in the sixteenth century, became the church of St. Maria Maggiore.

(*To be continued.*)

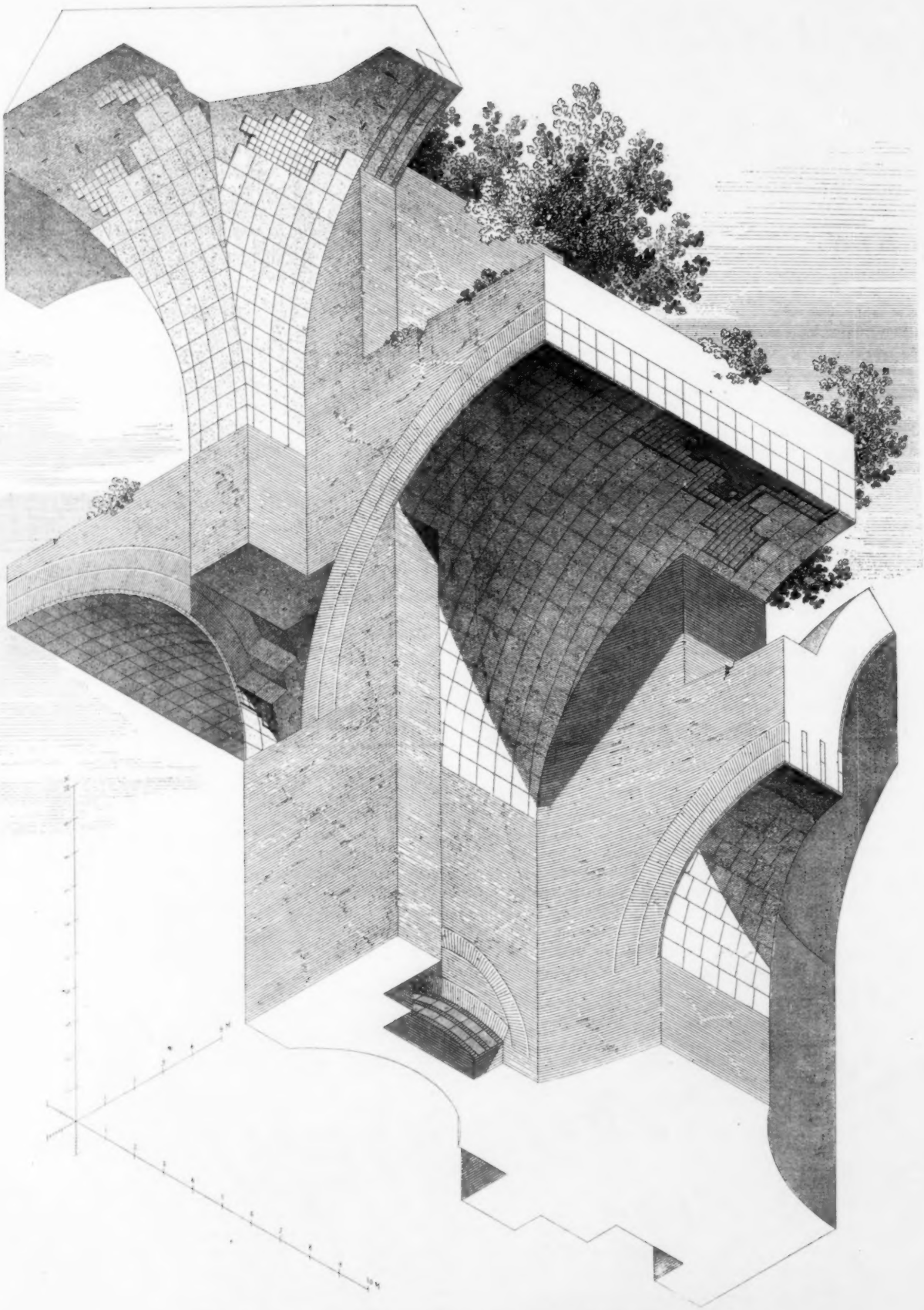


PLATE V. THE ART OF BUILDING AMONG THE ROMANS. (See Page 4.)

THE PEN-DRAWING OF BRICK ARCHITECTURE.

FIRST PAPER.

ON reading over my last month's BRICKBUILDER I happened on a very flattering mention of myself, in the prospectus for the coming year, in connection with a series of papers which are to bear the caption, "The Pen-drawing of Brick Architecture."

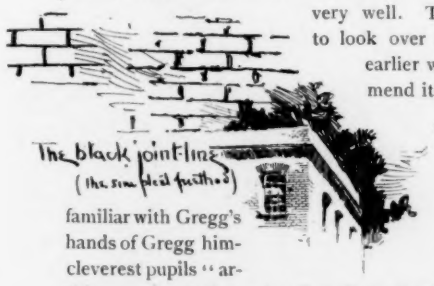
There is one word in that same prospectus to which I am ungracious enough to take exception, and that is, "entertaining." How, I ask, can one be entertaining on such a subject as the rendering of bricks? bricklaying is fun beside the rendering of them,—indeed the ordering up of a poor hod-carrier to the top of a high wall has something of the imperial in it,—but to take a pen and sprawl over a drawing-board while with infinite labour you draw in brick after brick is a very different thing.

No! that word "entertaining" grates a bit on my nerves; apparently I am cast for a funny man of some sort, and I am afraid the choice of subject will interfere with "my conception of ze part." Anyway, all the fun you may find will not, I promise you, interfere with the first intention of these papers, "The Pen-drawing of Brick Architecture."

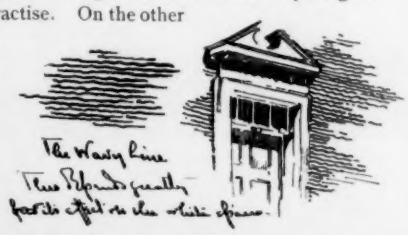
To begin with; for both our sakes, I earnestly hope and pray that the architecture you are about to tackle isn't too far away. There are only four or five men in America who can draw distant brickwork satisfactorily, and none or almost none in England. Even these few men are given to forgetting that such and such a palace or church or cottage is brick at all, and so with the aid of a spluttering toothbrush or lovely transparent shadows they produce something so beautiful that straightway you forget about the bricks too and are satisfied. But there! there! I'm not here to teach you tricks.

Brickwork can be drawn and drawn well, and satisfactorily to all concerned, though to tell the truth it's easier and less wearing on the patience of the draughtsman to render almost anything else.

Probably the first idea that will occur to the office boy, whose aspirations lead him brickwards, is to draw in with a black line all the joints, vertical and horizontal, and this sometimes serves its purpose very well. To prove it you have only to look over some of Joseph Pennell's earlier work. Yet I do not recommend it to any one unless he be of the highest ability, like Pennell himself.

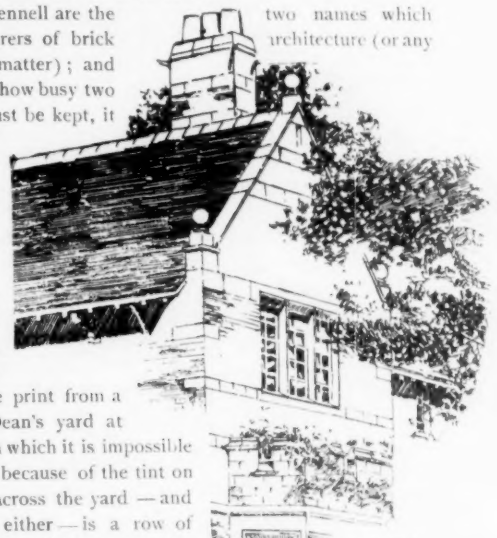


For distant work you are all of you probably familiar with Gregg's wavy line, which in the hands of Gregg himself and one or two of his cleverest pupils "arrives" delightfully; but this process looks easier than it is, for by far the greater number of those young ideas whom Mr. Gregg is teaching how to shoot only succeed in a very hard, mechanical imitation of his work, and none of them, unless we except Mr. Maginnis, have added anything of their own to the art they practise. On the other hand, however, many have brutalized all his methods until it is almost an insult to Mr. Gregg to recognize any echo of his own delightful handiwork.

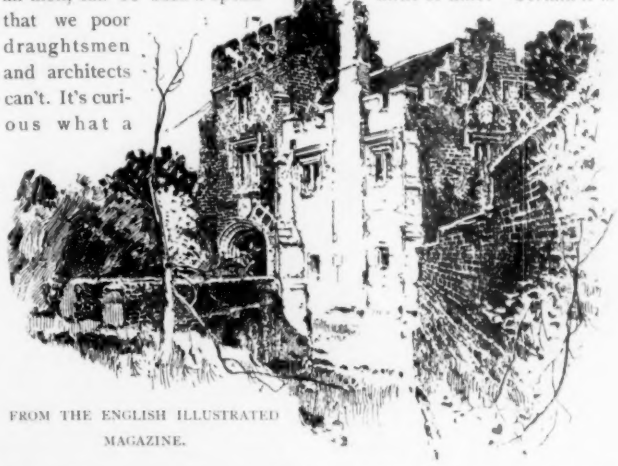


In the interval that has elapsed since I first apprenticed myself to an architect, there have appeared in England several men whose work is quite as good as our own, notably, Henry Wilson and C. E. Mallows. Wilson's work is wonderful, but do not attempt to follow it: you haven't time, for one thing, and for another, it is over the heads of the average client or committee as she is constituted in America. Mallows, however, is quite United States in style; and it is worth your while to notice the way in which he casts his shadows: not too severe parallel lines which invariably take the direction of the sunlight. This is a very ingenious dodge, in that it permits you to break up with little cloud-shadows and such like things big spaces of brickwork which it would be tiresome for you to cover, and tiresome for the beholder when so covered.

Railton and Pennell are the two names which come first as renderers of brick architecture (or any other kind, for that matter); and when one considers how busy two such great artists must be kept, it is surprising to find that of all draughtsmen they are probably the most careful and painstaking with their bricks. Witness this apparently rapid sketch of Buckden Towers by Railton. I have a copperplate print from a drawing of the Dean's yard at Westminster by him which it is impossible to reproduce here because of the tint on the plate. Away across the yard—and it is no little area either—is a row of brick houses, behind which looms the Abbey itself. In these houses he has drawn in the greater part of the bricks separately in solid black, in this same manner leaving the mortar joints white. The result is as near perfection as could well be desired, although it must have taken centuries to produce, and I am at a loss, I confess, to understand how he, of all men, can be such a spendthrift of time. Certain it is that we poor draughtsmen and architects can't. It's curious what a hurry clients always seem to be in; but "to hear is to obey," and so the most time-saving device is the best, though I have often seriously considered the propriety of having some one work, in cheerfully coloured worsteds on a perforated piece of cardboard the legend, "M. Angelo used up seven years on his set of drawings for St. Peter's, and made a failure at that," and then hanging it up in a conspicuous position in the office. It's a tempting scheme, but I suppose it wouldn't do.



FROM A DRAWING BY C. E. MALLOWS IN THE BUILDING NEWS.



FROM THE ENGLISH ILLUSTRATED MAGAZINE.

However, there are a number of ways in which time may be saved, and the effect be as good, if not better, in consequence. In these papers I hope to show examples of the better class of work, as well as from time to time adding thumb-nail sketches of my own when I cannot find illustrations which explain my meaning as satisfactorily.

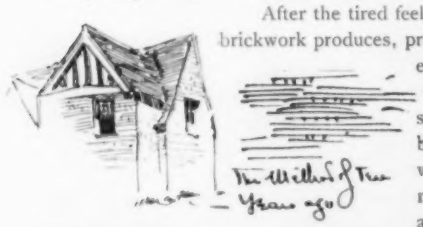
A few years ago, and it would have been an easy matter to give examples of all the good men, but of late the number of really excellent draughtsmen has multiplied tremendously, so I must content myself with but a few. Those of you who have read the first edition of

Pennell's monumental if somewhat narrow-minded book, "Pen-drawing and Pen-draughtsmen," will remember that he treated us all with but scant courtesy, mentioning favorably only Robert Blum and Beresford Pite, of whom the first is not an architectural draughtsman at all in the proper sense, and the other is an Englishman. But recently he has brought out a new edition, and here his stand is much more catholic. Why, he even gives Mr. Aubrey Beardsley quite a laudatory little chapter, besides printing one of Anning Bell's beautiful girls on his titlepage, — think of it! But with all his broadness, he can still see so little improvement in us that he doesn't even bother to rewrite or even to reprint his chapter on Architectural Pen-drawing. However, his elimination of it as it stood in the first edition may be taken as a sort of back-handed compliment. The truth is, I suppose, that he himself has such a pleasant pathway to tread in his own work, with his crumbling old Gothic cathedrals and white walled Italian towns, that he forgets that we are shambling along a byway of mushroom villas and cottages and what not, many of which have not yet appeared above the ground, (alas, how many of them never do!) or, at the most, for which the final certificate has but just been handed to the contractor.

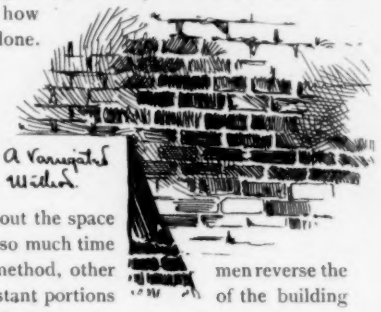
And this brings me to another point. Perhaps Mr. Pennell is quite right after all, because it is lamentably true that but one in a thousand draughtsmen ever bothers himself to study directly from nature, or, granting that his intentions are good in this respect, he has little time to do so.

DRAWN BY JOSEPH PENNELL FROM A "SUMMER VOYAGE," THROUGH THE COURTESY OF ROBERTS BROS.

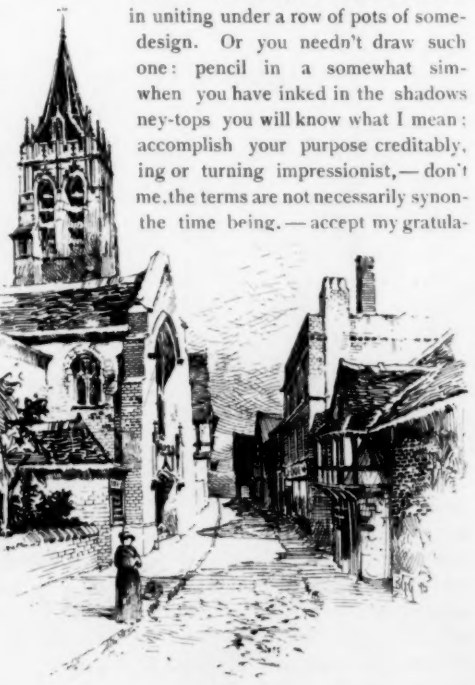
I'll wager that all the sketching from nature most of our very best men have done has been on their little poverty-stricken, hurried, and generally third-class-compartment European tours, for which they have saved for years, and have to see so much that they haven't time to draw. Some of us have never had even that "desert in our oases," as they say in "The Green Carnation," and so it is little wonder if we fall into a habit of setting imaginary types of things in the place of the things themselves, — type trees, type grass, type mountains, type brickwork, and, worse than all the rest, type beings, — I can't bring myself to write human beings, — type writers, type everything, — the Lord have mercy on us all!



After the tired feeling which the drawing of brickwork produces, probably the difficulty of covering large areas of blank wall without dulness or insipidity is the greatest drawback to success. In the work of a dozen years ago nobody appeared to feel this, and so they covered their big spaces like little men, with long and short stupidly horizontal lines, sometimes — though this was but rarely, and only the hardiest spirits attempted such feats — they clawed away, and with little nervous digs of the pen point suggested — save the mark! — a limited number of the vertical joints. Now, however, as I have said, we have changed all that, and any draughtsman with even the rudiments of imagination can think of things which will serve to break the monotony. Of course, to leave the white paper is one of the best expedients, and if this is done in just the right way nobody will know the wall isn't there. I can't tell you how to do it, only that it can be done. My own practice is to leave white the nearest part of the sunlit side of the building I am at work upon, at the same time giving so much more than the usual amount of attention to the shadows about the space that it is questionable if I save so much time after all. While I prefer this method, other men reverse the process by lighting the more distant portions of the building and intensifying the shadows there.



The next difficulty which comes to me is in complicated work, moulded brickwork, shadows from delicate pieces of detail, etc. To appreciate this you have only to draw a chimney-top with considerable projection. Think of some of those which Kirby is so fond of using, where three or four twisted and turned shafts in uniting under a row of pots of some-what similar design. Or you needn't draw such a complicated one: pencil in a somewhat simple one, and when you have inked in the shadows under the chimney-tops you will know what I mean: indeed if you accomplish your purpose creditably, without slouching or turning impressionist, — don't misunderstand me, the terms are not necessarily synonymous, — for the time being, — accept my gratulations, for you



A FREE USE OF THE BLACK JOINT LINE.

bid fair to make a successful draughtsman. Another difficulty is to draw with any degree of care without having the brickwork so drawn black out of all proportion to the rest of the sketch. So that while Railton's drawing of the Dean's yard at Westminster is drawn in this fashion, it is because he meant it to be dark and shadowy at this very spot. Inasmuch as the whole thing is in a very low key, the foliage in particular being quite as dark as the row of houses, it is probable that he was endeavoring to obtain the effect of the proverbial London atmosphere. Thank goodness we architectural men don't have to give much of our time to obtaining atmospheric effects in our work! Think of a *vibriste* or a *gris en gris* draughtsman! Eh?

BERTRAM G. GOODHUE.

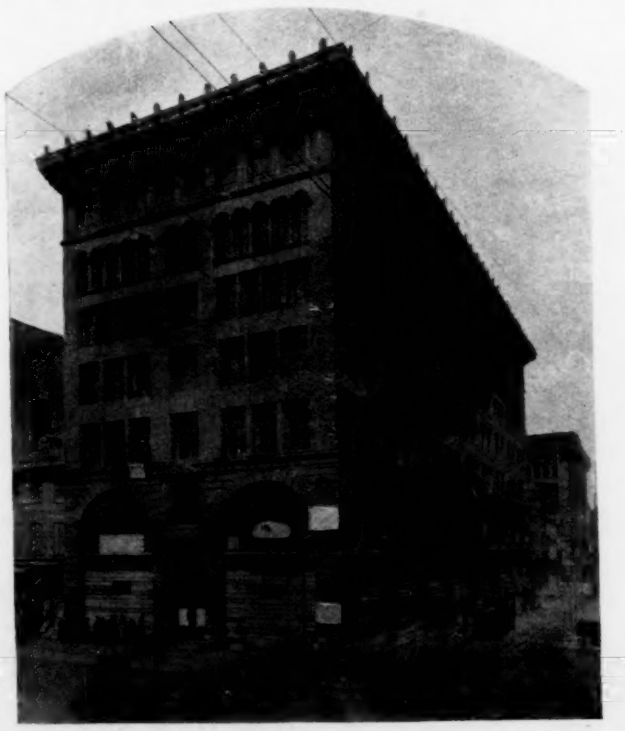
RECENT BRICK AND TERRA-COTTA WORK IN AMERICAN CITIES.

TERRA-COTTA FIGURE IN HIGH RELIEF.
ODD FELLOWS' TEMPLE.
Executed by the Perth Amboy Terra-Cotta Co.

PHILADELPHIA.

STORE BUILDING CORNER OF TENTH AND MARKET STREETS.

THE building is divided horizontally into a base, including the two lower stories, — the main body, which takes up four more, — and the entablature, which includes the seventh story. Naturally, the treatment of the base is as horizontal as possible, in order to satisfy the eye. But it is to the main part of the building — that is to say, the four stories over the round arches — that we wish to call attention. A very common and very obvious thing to do in a design of this kind is to use up all the wall space by pilasters, or shafts, or columns, whole openings between them being window spaces.



STORE BUILDING, CORNER TENTH AND MARKET STREETS.

A very unfortunate effect of this is to produce the impression on the eye of an immense vertical thrust, which thrust seems by no means satisfactorily carried on the light and open base. It is in vain that the designer decides to dispense with any such vertical treatment so long as he places the windows in their natural constructive position ; that is to say, one directly over another and of the same size. The effect of the vertical line of masonry is still there. It has, therefore, occurred to us to use a motive very common in the Italian brick towers, of making the width of the windows of each story a little greater than those immediately below. The vertical sides of the opening formed by all the windows thus seem to converge toward the bottom, which naturally produces the illusion that the sides of the tower converge toward the top more than they actually do, and gives, as everybody knows, an effect of lightness and strength. In this design we have tried the adaptation of this principle in repetition on a long wall, and we think we can say, that without doubt, in looking at the building, in reality it gives the impression of a homogeneous wall instead of a succession of isolated piers. The wall, unquestionably, looks lighter, and at the same time stronger, than if the openings had been all of them of the same width. The height of the windows and the vertical wall space between them have also been diminished towards the top. On the whole, the experiment is reasonably satisfactory, and in the design of the terra-cotta building now in course of construction, which will be shortly published in THE BRICKBUILDER, we hope to show that the same idea may have still better results in a higher building than this, especially when the mouldings around the windows in all the stories are kept exactly alike, and when the outside wall itself has a slight entasis.

COPE & STEWARDSON, *Architects*.

ODD FELLOWS' TEMPLE,
BROAD AND CHERRY STREETS, PHILADELPHIA.

THE building is nine stories high, one hundred and twenty feet on Broad Street, and one hundred and seventy feet deep on Cherry Street. It is considered to be one of the handsomest buildings in Philadelphia, built of cream-colored Roman brick of Eastern Hydraulic make, and terra-cotta white in color made by the Perth Amboy Terra-Cotta Company.

The arched entrance is twenty feet wide by thirty feet high, with a vestibule twenty by twenty feet, which opens into the grand court and stair hall, to the rear of which is the auditorium, forty feet high, sixty-six feet wide, and nearly one hundred feet long, free of columns. The second, third, fourth, and fifth floors will contain offices, there

being over one hundred in all. The upper floors contain lodge-rooms, encampment rooms, and banqueting hall, etc.; drill-room in basement. Flooring is of steel girders, with terra-cotta floors and partitions; fireproof. J. E. & A. L. Pennock, builders; Hazlehurst & Huckel, architects.

MUCH attention is now paid to methods of fireproofing the steel skeletons of buildings erected at the present time, especially in the case of structures intended for public purposes. A notable illustration of this feature is presented in the treatment of the great girders of the new Tremont Temple in Boston. The steel girders are first placed in terra-cotta blocks, on all sides and below, these blocks being then strapped with iron all around the girders, and upon this is stretched expanded metal lathing covered with a heavy coat of Windsor cement; over this comes iron furring, which receives a second layer of expanded metal lath, the latter, in turn, receiving the finished plaster. There is consequently, in this arrangement for fire protection, first, a dead-air space, then a layer of terra-cotta, a Windsor cement covering, another dead air space, and finally the external Windsor cement. These great girders are characterized as the vital parts of the whole steel structure, the necessity of their absolute protection being explained by the fact that a rise in temperature of 300° would throw the columns out of place about an inch and a half on each side, and a rise of about 500° would ruin the steel. Another feature to be noted in this work relates to the partitions of the outside corridors about the auditorium, these being built of terra-cotta blocks, held securely in place by means of angle irons, and bound together by expanded metal lathing on each side, upon which is placed the plaster.

HEADQUARTERS OF THE BROOKLYN FIRE DEPARTMENT.
FRANK FREEMAN, ARCHITECT.

THE FIRST NATIONAL BANK of New Haven, Conn., are erecting a handsome office building which will be modern in every particular — brick exterior, steel construction, and fireproof. L. W. Robinson, architect.

THE new catalogue of The Central Press Brick Company of Cleveland is certainly a most artistic affair, and its mission, as stated, "to give a faint idea of the possibilities that can be obtained from the artistic use of pressed brick," is well accomplished. There are some forty sketches of different styles of mantels, with description beneath each sketch. The designs of these vary considerably, and it would seem that with such an assortment to select from it would not be difficult to find a design to one's taste. We consider some of the mantels very excellent in point of artistic construction, and congratulate the company on the publication of so attractive a pamphlet.

THE extensive use of enamelled brick in the dynamo rooms in the sub-basement and the twenty-two treasury vaults located in the New State House is evidence of their value as light reflectors, fireproof qualities, non-conductors of moisture and odors, and durability. This is the practical phase of the matter in a nutshell. The artistic features of the Somerset enamelled brick are also worth looking into. Here are some beautiful examples of these mellow white brick, so rich in lustre, so deep and pure in tone, and so receptive in color that one could live in a room whose mural finish was composed of just such agreeable material. To the eye — and for that matter, architects and those who have used these bricks extensively assert their equality in all points with the imported — they are wholesome adjuncts in interior decoration, rather adding to than detracting from the designer's or colorist's art, — a point worth considering in the adornment of residences, offices, public or monumental buildings. It is pleasant to note that Architect Brigham has so favorably indorsed this material by its use in the State House, thus extending its popularity and admitting it to be adapted for almost endless uses. The fireplaces, arches, or like localities where catchy angles or curves are to be used, find in the material an accommodating medium, and the advocacy of its use in school halls, corridors, and sanitaries is timely.' — *Boston Herald.*

HAVE you renewed your subscription to THE BRICKBUILDER for 1895?

THE BRICKBUILDER FOR 1895.

It has become the custom for all periodicals having anything to announce to publish a prospectus for each coming year. As we have a great deal to announce, this custom becomes a necessity in our case. The space we can allow ourselves for advertisement admits of only the most general statement, but with the past year's record of advance in both quantity and quality of published material, we think our subscribers will trust us with satisfactorily carrying out in detail what this prospectus outlines.

REGULAR FEATURES.

Brick and Marble in the Middle Ages.

WITH the December number we finish the first half of our reprint of Street's "Brick and Marble in the Middle Ages." Paradoxical as it may seem, the half that is to come will be twice the size of the half we have covered. This is due to the much better chance the latter part of the book offers for supplementary illustrations, enabling us to publish a much larger proportion of photographs than in the past.

The Art of Building among the Romans.

MR. DILLON'S translation of Choisy's "L'Art de Batir chez les Romains" will be continued, and will present 75 engravings of construction in the text and 23 full-page plates drawn in the same masterly way that characterizes the plates published in May and August. The fact that this article has secured as subscribers whole classes in the various architectural schools should commend the paper on this account alone to all students and draughtsmen.

Recent Brickwork in American Cities.

WE now have an unequalled corps of contributors, covering every American city of importance. In most instances our correspondents are architects of the best standing, thoroughly acquainted with all that is good in their respective cities, and commanding the services of draughtsmen who are particularly brilliant as illustrators. There will be hardly an issue of next year that will not present the cream of recent work in some American city.

Scale Drawings of Current Work.

AS in the past, a large portion of the paper will be devoted to carefully selected scale drawings of elevations and details, of both ornament and construction, representing the best projected work in this country. What the paper has been in this respect is all we need promise for the future. With its increasing strength and popularity, however, it is offered a larger selection of material, which can only result in raising the standard of quality.

SPECIAL DEPARTMENTS.

Our readers cannot help noticing the growth of the several departments into which that part of the paper following the editorial page is divided. These will, during the year, assume the importance of independent periodicals. Even greater care will be observed in their editing than in the preceding part of the paper, and specialists of the highest reputation will contribute. To go into detail as to the staff of writers connected with these departments would take several pages. Only their general character can be here stated.

The FIREPROOFING department will contain special articles, discussions and construction details devoted to building for protection against fire; it will keep pace with the improvement in construction which is being daily made. In MORTARS AND CONCRETES we have a strongly growing periodical in itself, one that will be found invaluable to all architects who recognize the necessity of care in successfully employing cementing materials. In the pages devoted to the MASON CONTRACTOR a practical discussion of those matters most needed by the builder, and as yet supplied by no other publication, will be associated with useful details and designs for the smaller class of buildings. In the department of THE MANUFACTURER special attention will be devoted to the market side of the brickmaker's business.

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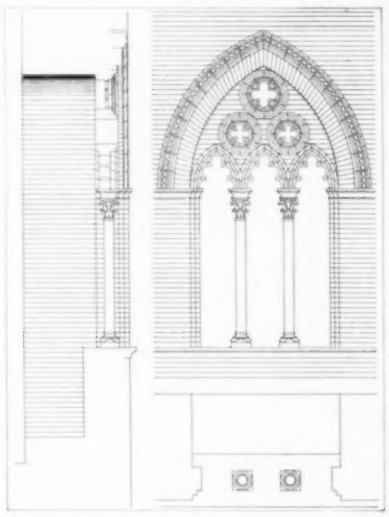
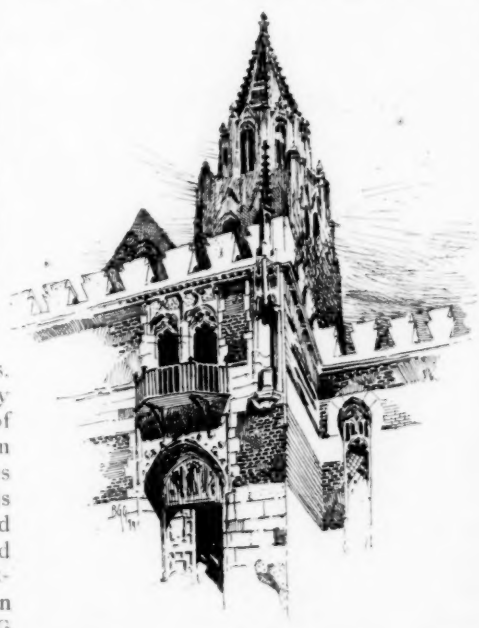
Subscription price, $2.50 per year in advance.

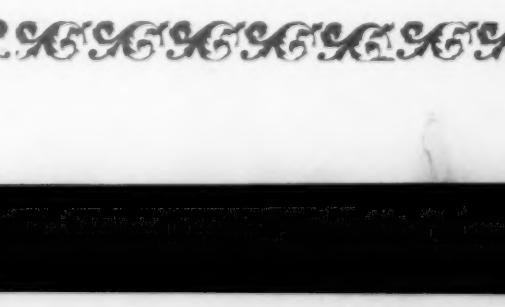
Special Features of THE BRICKBUILDER for the Coming Year.

TO Italy one naturally turns first for inspiration from Architecture in Materials of Clay, and it is to be expected that in selecting our special features, we give a prominent place to the examples she offers us. The Campanile is an architectural motive in which Italy is particularly rich, and we are fortunate in securing from MR. C. HOWARD WALKER a series of articles upon ITALIAN BRICK TOWERS. These articles will treat of the several types, with the best example of each, and will be both historical and critical. They will be most profusely illustrated with photographs, and Mr. Walker's unpublished sketches. ❧❧❧ With the increasing interest in the architectural use of glazed and enamelled terra-cotta, attention is turned more and more to Italy, where this art, since lost for several centuries, originated and reached perfection. Very timely, therefore, will be our articles upon THE WORK OF THE DELLA ROBBIAS, and no one is a more close or appreciative student of this work, or better fitted to write upon it, than PROF. ALLAN MARQUAND, of Princeton. The articles will be most fully illustrated by photographs from Prof. Marquand's very complete collection. ❧❧❧ Measured drawings of foreign work, when intelligently selected and skilfully executed, are immensely valuable, and we promise our readers a treat in the TWELVE SHEETS OF MEASURED BRICK DETAILS which constitute our third "Italian" feature, to be prepared by MR. C. H. ALDES, who sails this month for Genoa.

Next to Italy in interest for us is Holland, a country whose brick architecture should be better known. MR. R. GLIPSTON STURGIS has consented to write upon THE BRICK ARCHITECTURE OF HOLLAND, and no one has a more intimate acquaintance with the subject, or a larger fund of photographs and sketches to draw upon for properly illustrating such articles. Mr. Sturgis's sketches lend themselves admirably to reproduction, as the accompanying sketch of a house at Dordrecht shows, and it will be on this account one of the most attractive articles of the year. ❧❧❧ What American architect is there, who knows the difference between good and bad drawing, that does not know and admire the brilliant pen drawings of MR. BERTRAM G. GOODHUE? No draughtsman can afford to lose the articles which Mr. Goodhue will write upon THE PEN DRAWING OF BRICK ARCHITECTURE, with their many illustrations from the work of prominent draughtsmen, and the author's many little bits explaining methods of effective rendering. Mr. Goodhue is as brilliant a writer as he is a draughtsman, and has the faculty of making his subject thoroughly entertaining as well as instructive. ❧❧❧ BRICK IN COTTAGE ARCHITECTURE is a subject which we have tried for three years to have satisfactorily treated, and we have now a writer who has thoroughly interested himself and will do the subject full justice. MR. RALPH ADAMS CRAM will write several papers taking up both the practical (the economic and constructive) and the æsthetic sides of building small houses with brick, and will illustrate them with floor plans, perspectives and constructive details. We reserve mention of MR. H. LANGFORD WARREN to the last, as the subject he will take is yet to be decided upon, but we need say nothing more than that he will write upon something. We think the above programme, taken with that upon the preceding page, will convince present subscribers that no effort will be spared to make the coming year fully worth their continued patronage. To intending subscribers we suggest comparison of our paper with others seeking your patronage, on the points of QUALITY, QUANTITY, AND PRICE.







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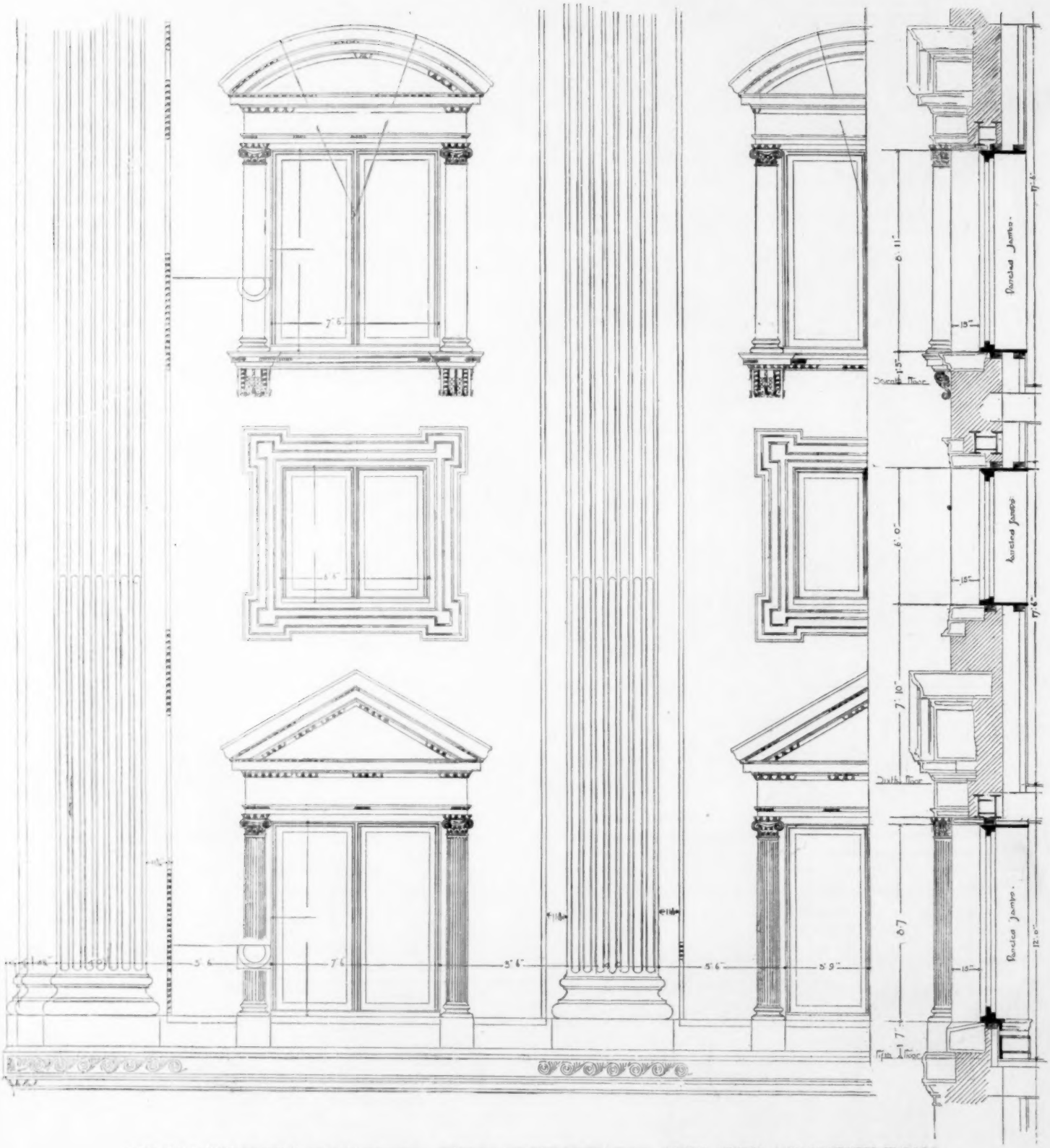
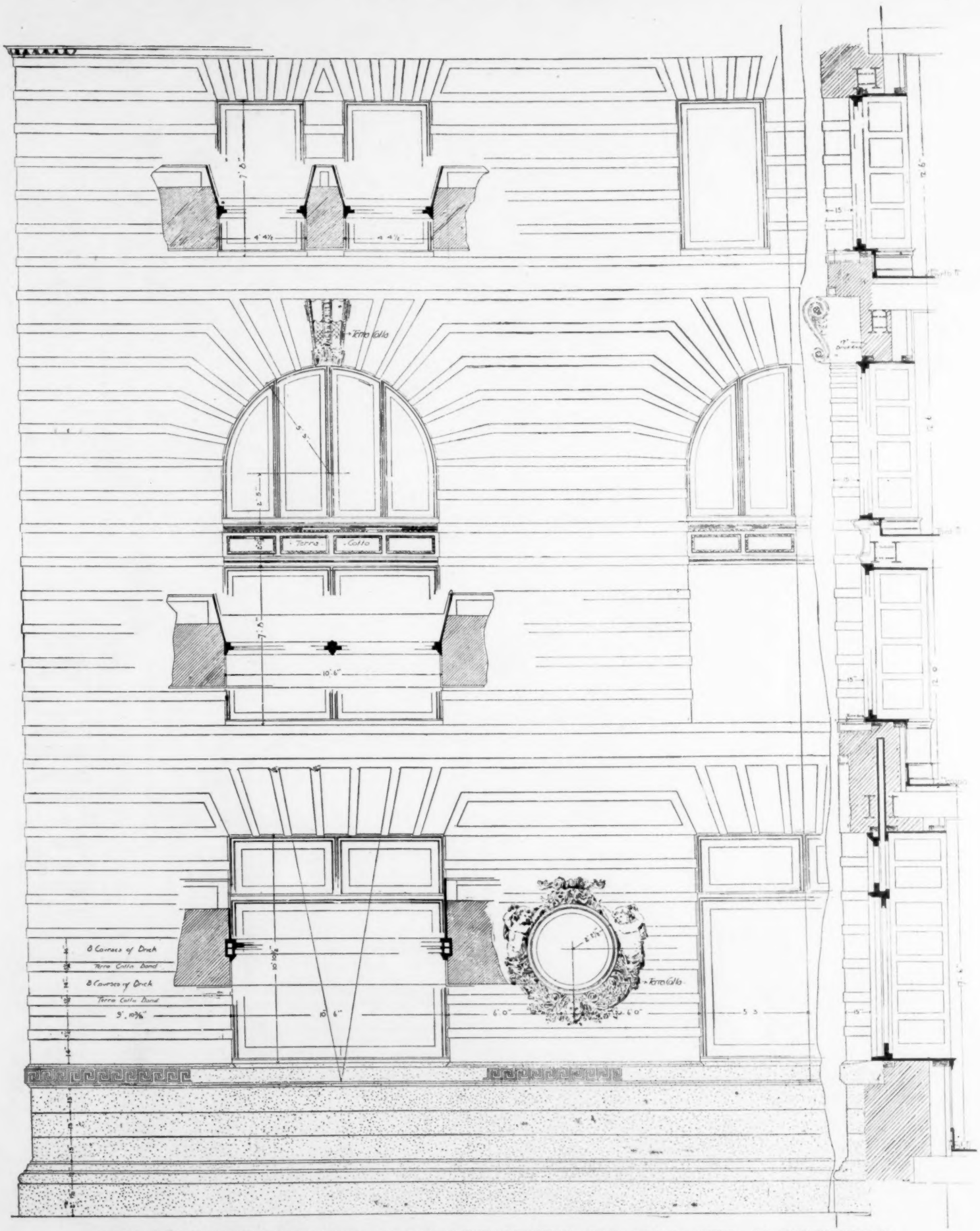
ODD FELLOWS' TEMPLE, PHILADELPHIA. UPPER PART OF CHERRY STREET ELEVATION.
HAZELHURST & HUCKEL, ARCHITECTS. (See page 9.)



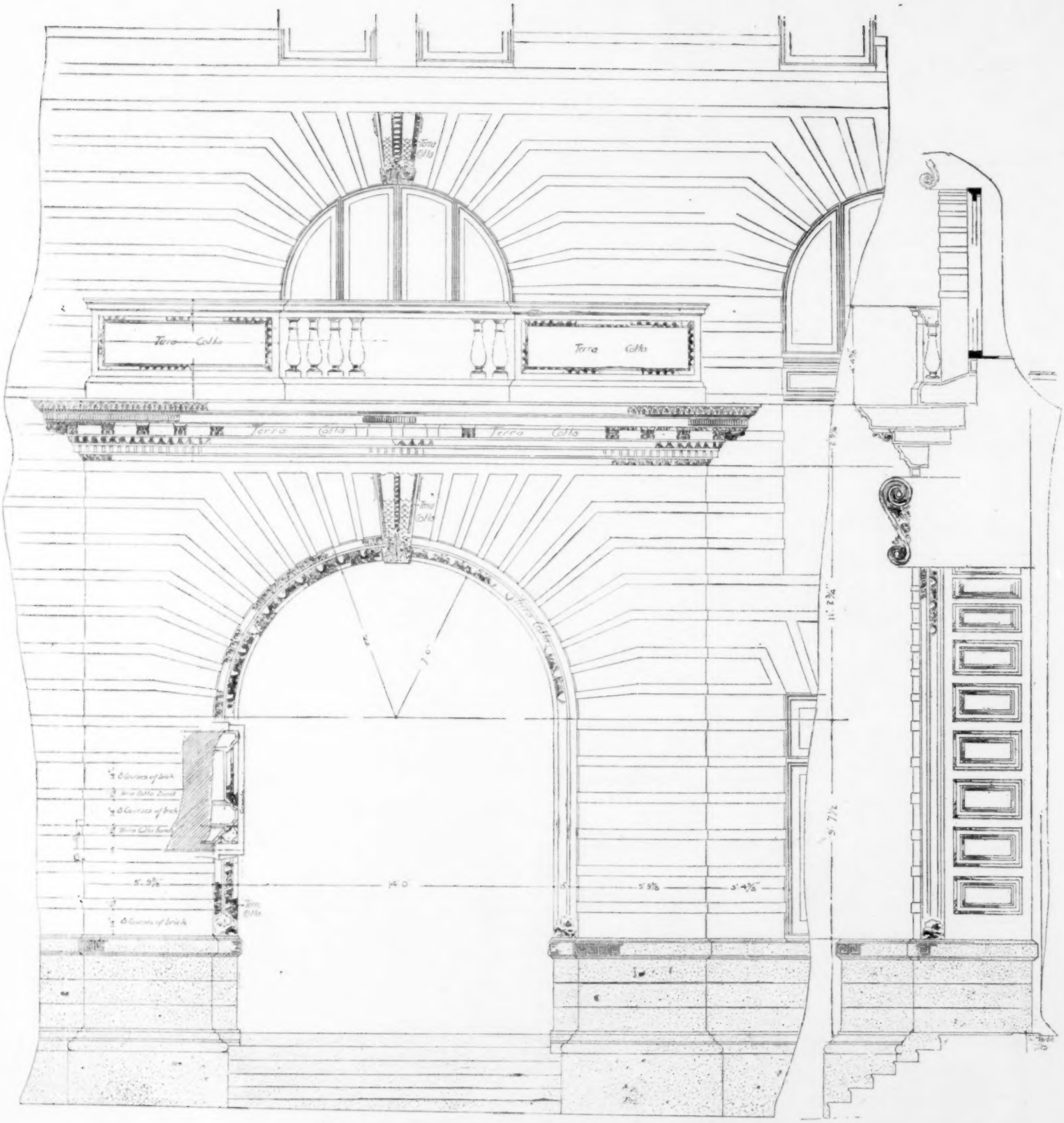
ODD FELLOWS' TEMPLE, PHILADELPHIA. CHERRY STREET ELEVATION. FIFTH, SIXTH, AND SEVENTH FLOORS.

HAZELHURST & HUCKEL, ARCHITECTS. (See page 9.)



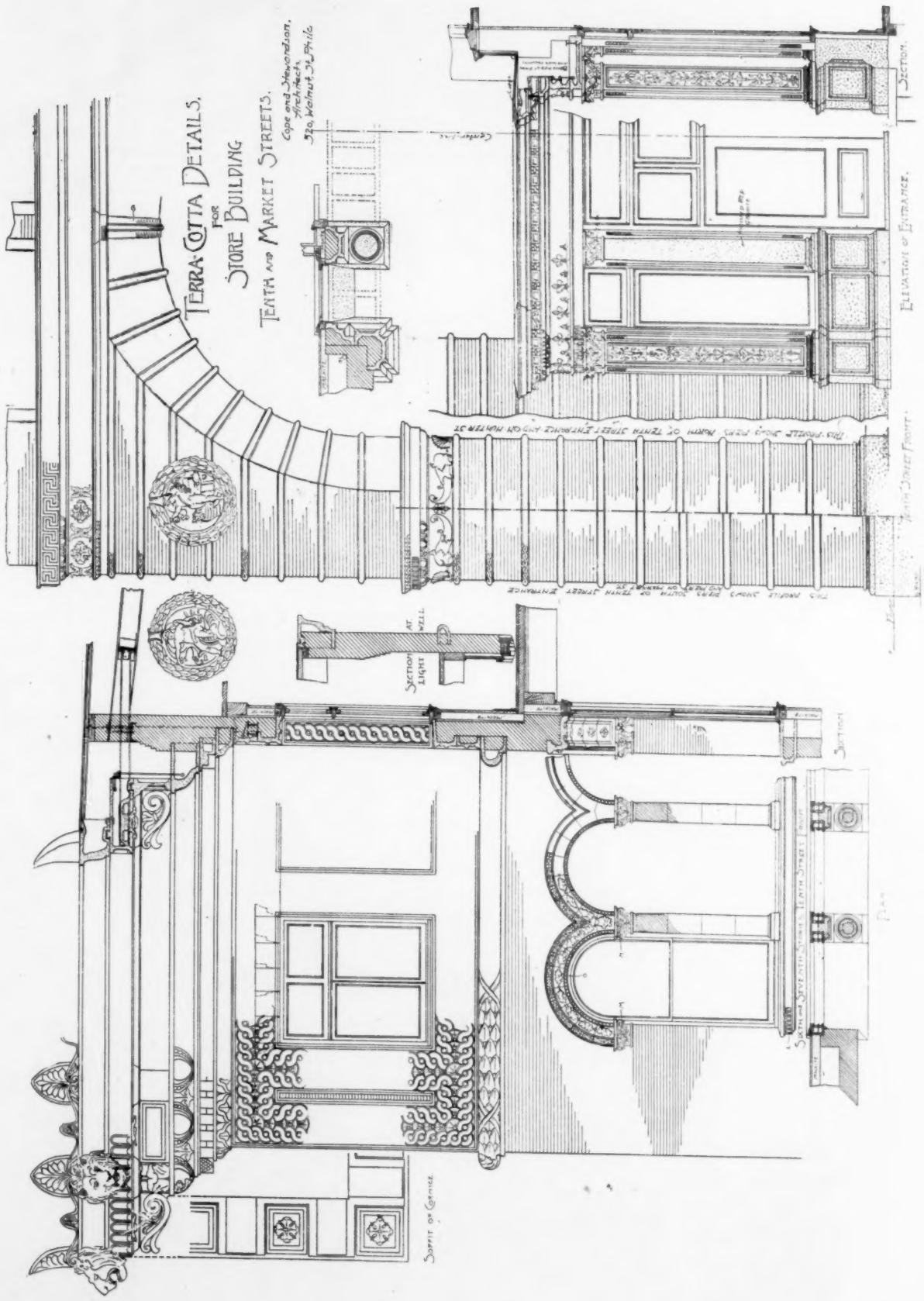
ODD FELLOWS' TEMPLE, PHILADELPHIA. CHERRY STREET ELEVATION. FIRST, SECOND, THIRD, AND FOURTH FLOORS.

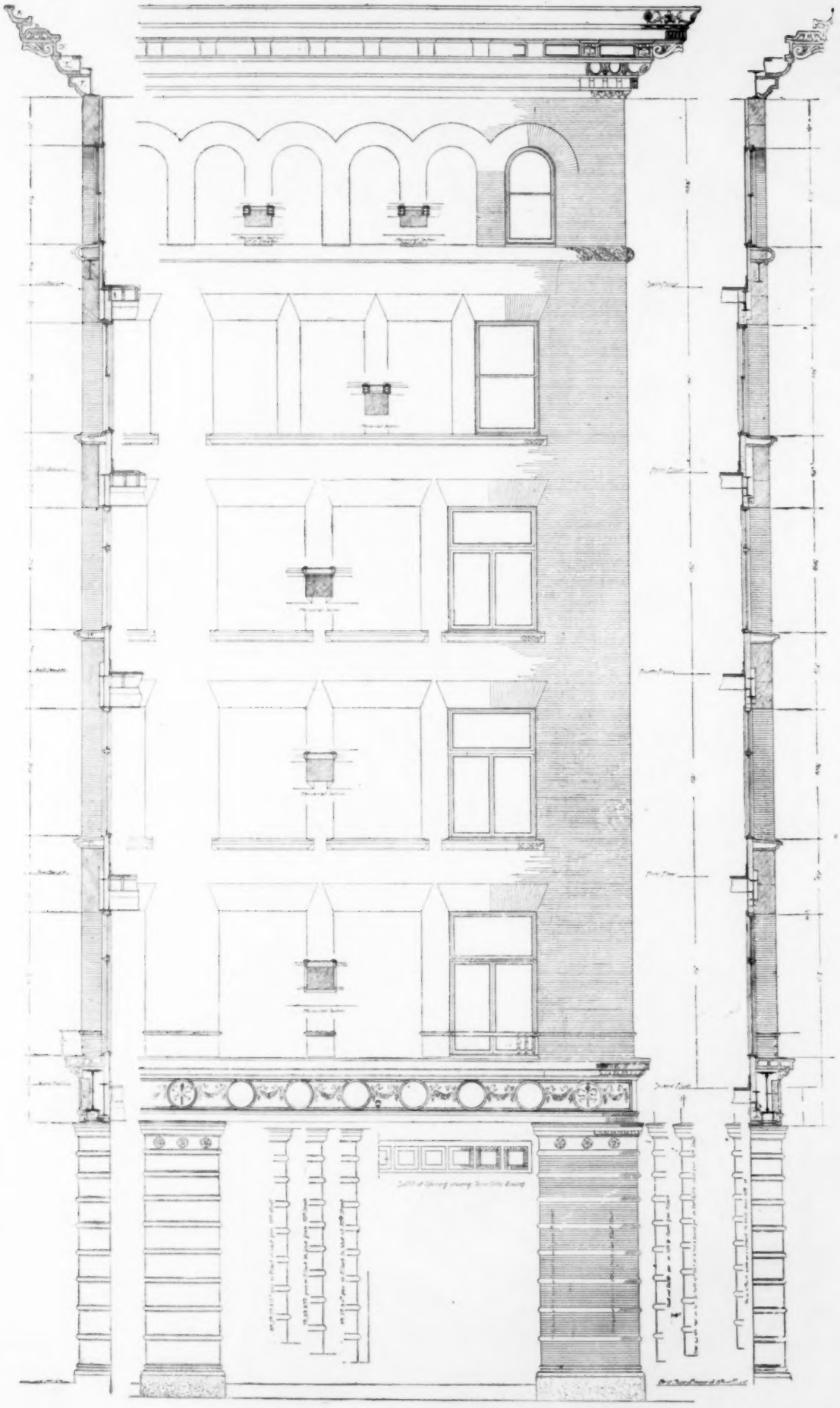
HAZELHURST & HUCKEL, ARCHITECTS. (See page 9.)



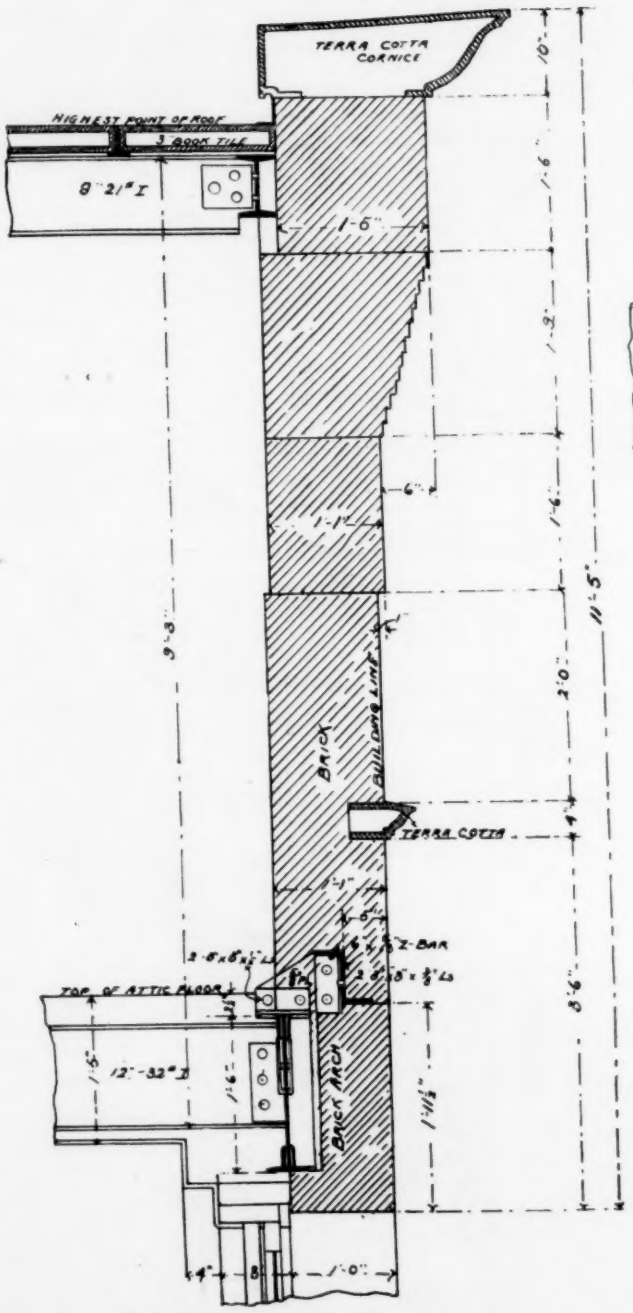
ODD FELLOWS' TEMPLE, PHILADELPHIA. CHERRY STREET ENTRANCE.

HAZELHURST & HUCKEL, ARCHITECTS. (See page 9.)

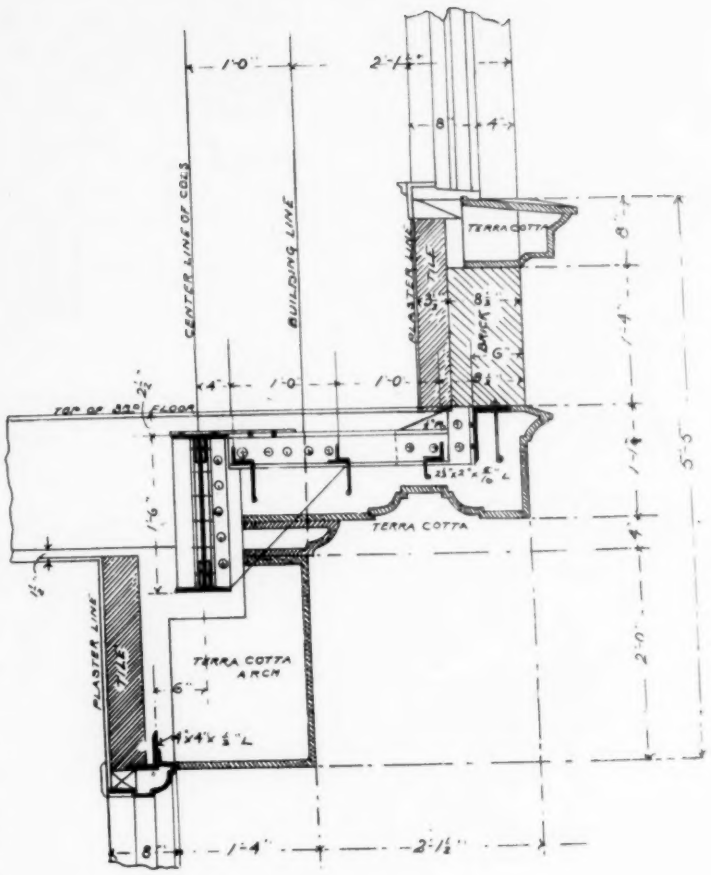

TERRA-COTTA DETAILS.
FOR
STORE BUILDING
TENTH AND MARKET STREETS.
Cope and Stewardson, Architects, 320 Walnut St. Phila
Section.
Elevation of Entrance.
Section at well Light
Section
Plan
Soffit of Cornice



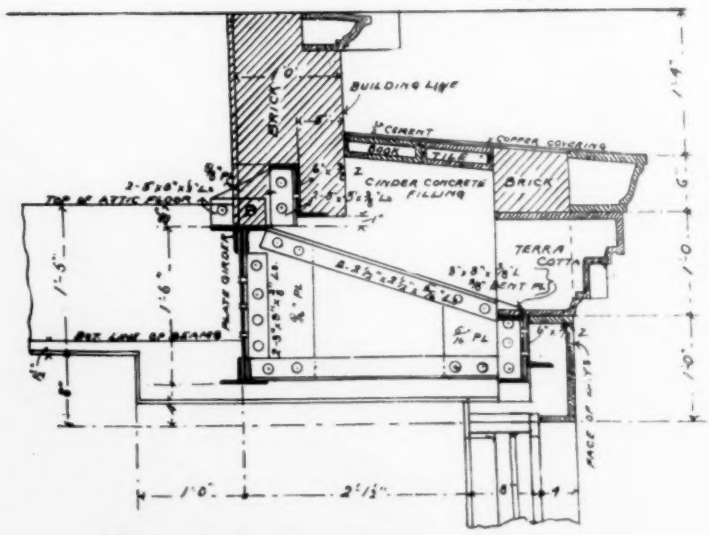
ELEVATION OF CORNER BAY ON FILBERT STREET, PHILADELPHIA. STORES FOR C. C. HARRISON, ESQ.
COPE & STEWARDSON, ARCHITECTS. (See page 9.)



SECTION THROUGH ATTIC



SECTION THROUGH BOTTOM OF ALL BAYS 3RD FLOOR.

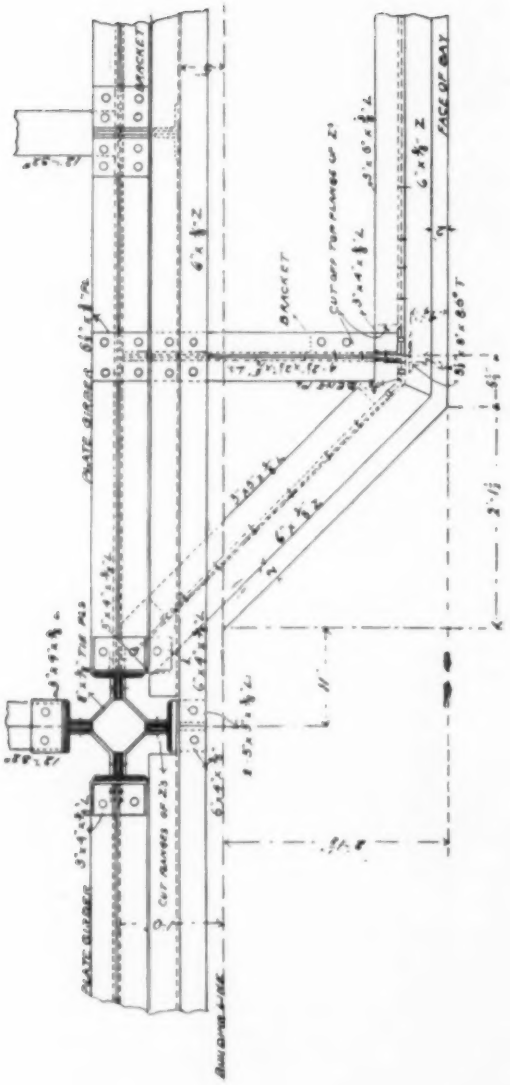


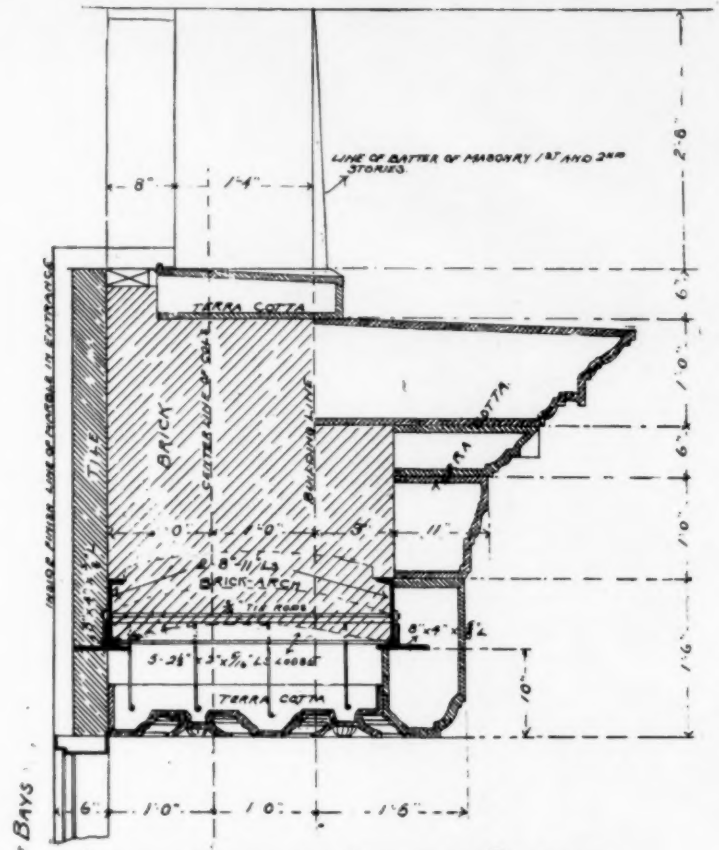
SECTION THROUGH TOP OF BAYS

WYANDOTTE BUILDING.

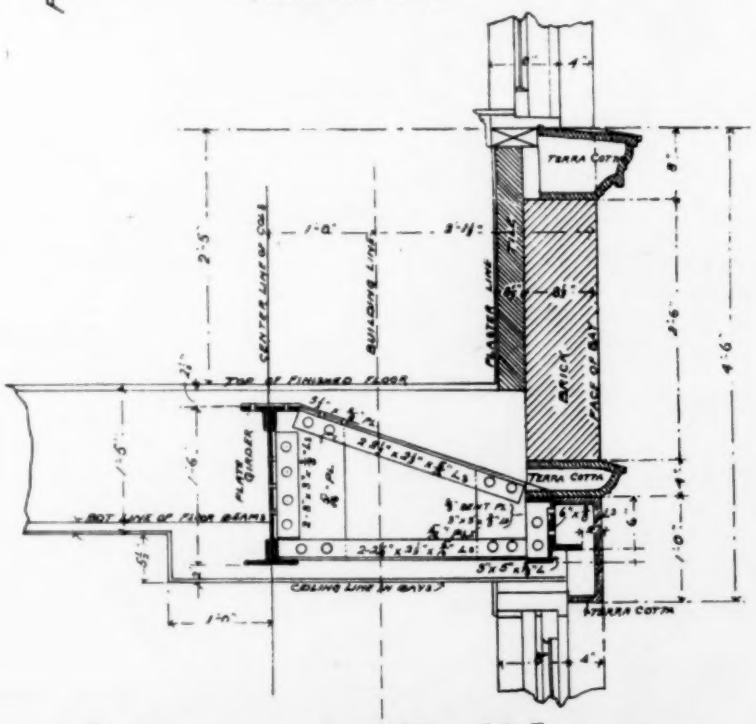
SCALE 0 6 12

DETAILS OF FIREPROOF CONSTRUCTION. (See page 13.)





SECTION THROUGH TOP OF ARCH NORTH ELEVATION
MAIN ENTRANCE



SECTION THROUGH ALL BAYS 4TH TO 11TH FLOORS INCLUSIVE

WYANDOTTE BUILDING.

SCALE 0 6 12 I.M.

DETAILS OF FIREPROOF CONSTRUCTION. (See page 13.)

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

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No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connections, editorial or proprietary, with this publication.

A COLOR TREATMENT OF TERRA-COTTA.

AMERICAN architecture is notable for the almost total absence of the accidental. Architecture has been carried in this country to a point where it exhibits in many instances most careful study, but we have not yet been able to unite a scholarly study of design with the accidental touches which are found so charming in connection with the work of older peoples. It is difficult to deliberately simulate such accidental effects even by the most careful study, because, after all, the happiest features of this sort are so purely the result of hazard and of the weather. As far as relates to pure design, the accidental as an adjunct of architecture is, on the whole, to be deplored, but when the consideration of color is involved — and it is a consideration which cannot be entirely disassociated from any architectural conception — it is to the accidental that we look for our happiest effects.

Of late years terra-cotta has become by natural selection the most promising medium with which to experiment in color for external effects. The temptation to use colored terra-cotta is a strong one, but the uncertainty of the actual results has made nearly all of the attempts very timid and halting in their character. The impossibility of change after the material is once set, and the difficulty of judging the effect until the whole is in position, complicate the problem to an unusual extent. Any attempt therefore to adapt colored terra-cotta to the design of a building is always of interest.

IN designing the exterior of Tremont Temple, Boston, the architects, Messrs. Blackall and Newton, have aimed to make color a very essential and predominating feature of the design. The principal portion of the façade, extending through a height of about fifty-two feet and a width of ninety feet, is an almost unbroken wall surface, and is faced entirely with terra-cotta blocks about 5¾″ x 11″, disposed in a diagonal zigzag pattern something after the style of the exterior walls of the Doge's Palace at Venice. In the Venetian example these blocks are of marble mottled by time and weather in a great variety of hues and yet blended in a delightful manner, so that while the pattern is quite apparent the general effect is not disturbed. In a modern building there would be several possible color treatments of a pattern of this nature. The most simple and possibly the safest would be to employ at the most three harmonious shades of the same color, alternating them sufficiently to accentuate the pattern while not permitting a great variation in tones. This might give a soft, pleasing effect, but could hardly be called color. Another treatment would be to use two or three contrasting colors repeated at regular intervals like a stencil. This has been tried in a very conspicuous New York church, which, as an unfortunate result, has acquired the sobriquet of "The Church of the Holy Oil Cloth."

NEITHER treatment has been followed in Tremont Temple. The front has been considered as a whole, and an attempt made to reproduce to a certain extent some of the accidental qualities which lend such a charm to the Doge's Palace. Fifteen distinct colors of terra-cotta are used, ranging from almost pure white through buffs, pale browns, deep red, and grays, to a medium green. These colors were not disposed in any regularity over the surface, but in designing the work the entire front was first studied on paper in the actual colors, and the blocks grouped so as not only to bring out the pattern but also to vary and modulate the whole scheme, so that, starting with grayish tones at one lower corner, and with pink tones at the other, the front merges gradually into lighter or more pronounced tones at one upper corner, and fades into pale buffs at another. This is an effect which is simply impossible to describe, and is also impossible to lay out fully on paper in advance. Consequently, after the color studies were carried as far in the office as possible, the actual blocks were laid out full size on the ground at the terra-cotta works at Perth Amboy, each block being put in position, shifted, transposed, or rearranged, until the desired effect of contrast, gradation, and harmony seemed to be perfectly satisfactory.

The work was first so laid out on a clear, bright day, and was subsequently reviewed on a cloudy day, as well as immediately after a rainstorm, and as the rain changed the values of every color used in the terra-cotta, when the colors were wet many changes suggested themselves. The blocks were finally arranged in what seemed to be the best manner, were then numbered, and shipped to Boston, where, during the whole process of erection, they are carefully watched by the architects, and such corrections in color made from time to time as are suggested by inspection in place. In other words, this portion of the front is treated precisely like a huge mosaic, every one of the ten thousand blocks being studied both beforehand and in place in its relative and absolute values so as to produce a surface which shall be a harmonious whole.

The pattern work is framed in a broad band of white modelled terra-cotta on each side and across the top. The two stories above the diaper work, also the details about the few window openings in this work, are executed in white terra-cotta, and the masonry of the two stories immediately below it is of soft-toned Indiana limestone closely matching the colors of some of the terra-cotta facings. The blocks are all laid up in white lime mortar. The effect of the white joints will undoubtedly be a little staring at first, but the lime will blacken so quickly with the atmosphere that the jointing will not count for a great deal.

IT goes without saying that this is a very decided innovation in the color treatment of the exterior of a building. As the work is not yet entirely completed, it is different to judge of what the result will be. Indeed it might almost be said that no correct conception of the effect can be had until after the building has been occupied a sufficient length of time for the elements to have added their touch to the final mellowing of the whole. The colors are certainly not arranged by mere caprice, but on the contrary are studied with a distinct general idea in view. Every one knows the tiresome monotony of a perfectly plain wall surface which presents no variations in color, and every one knows, on the other hand, the delight which is afforded by the contemplation of a wall surface broken up in the multitude of tones and shades which characterize the Doge's Palace at Venice. Tremont Temple shows a deliberate attempt to treat the front of a building exactly as one would treat a water-color. The tones are graded and softened into each other, the lines of the diaper work are blended together, and thus far there is not the slighest suggestion of the oil-cloth effect which might easily present itself without the most

careful study and supervision. However successful the scheme may finally be considered, it is certainly a daring attempt to break the monotony of the average commercial building. The building will be either greatly admired or strongly detested, and the outcome of the experiment will be watched by every artist with a great deal of interest.

THE following is from the inaugural address of Mayor Curtis: "I recommend that the Architect Department be abolished. The City of Boston, unlike some of the other great cities of the country, has no 'board of public works' upon which falls the responsibility for the construction of all its buildings. On the contrary, its affairs are managed by departments. Each department should transact all its business, and if appropriations are made for new buildings for any department that department should employ an architect to draw the necessary plans and supervise the work, and should be responsible for the result.

"I believe that competition among architects would result in the city's obtaining the services of the best men in this profession, that the style and character of our public buildings would be improved, and that on the whole the work would be performed more expeditiously and at less expense.

"I wish it distinctly understood that in making this recommendation I do not reflect on the present city architect, nor on any of his predecessors in the office. In fact, I think the present incumbent of the office agrees with the recommendation. The salary paid the city architect — $3,500 — is not, in my judgment, sufficient to command what should be the exclusive services of the best talent, while the buildings erected by the city are among the most expensive and noticeable. That we have in the past secured temporarily men of high standing in the profession is no guarantee that we shall be so fortunate in the future.

"The frequent changes in the office have often made it necessary for an incoming architect to complete the unfinished work of his predecessor in office, and where faults in construction and excessive cost have resulted it has been difficult to place the responsibility."

THE Boston *Herald*, in commenting on the Mayor's recommendation, says: —

"The recommendation that the office of city architect be abolished is one which we should like to qualify by suggesting that, instead of having the various heads of departments decide the character of the public buildings that are to be erected, all competing designs made by architects should be approved before they were accepted by a board made up, say, of the Mayor of the city for the time being, the president of the Society of Fine Arts, and the president of the Architects' Society. If some such check is not placed upon the judgment of the average head of a municipal department, we are inclined to think that we shall have in the future some public buildings that are both fearful and wonderful in the character of their artistic composition."

Mr. Wheelwright is entirely in accord with the Mayor's recommendation so far as abolishing the office is concerned, but in an open letter suggests a plan for the governing of this part of the city's work which differs from those proposed by his Honor.

YIELDING to the demand from many of our subscribers, and with the conviction that the usefulness and attractiveness of THE BRICKBUILDER will be largely enhanced, we have decided to take from our reading columns all advertisements. In doing this we are strongly of the opinion that the interests of our readers and advertisers will be better served. In connection with this change, we would call attention to the rearrangement of the Index to Advertisements, on page xix, which, we believe, will be found to be most comprehensive and useful.

OUR ILLUSTRATED ADVERTISEMENTS.

A VERY attractive feature in this month's issue is the large number of half-tone illustrations of brick and terra-cotta work, old and new, which may be found in our advertising columns.

CAMPANILE OF THE CHURCH OF ST. JOHN'S AND ST. PETER'S, ROME,

is the subject of this month's illustration, which appears in the Hydraulic-Press Brick Company's advertisement (see page xvii).

FIFTH AVENUE THEATRE, NEW YORK.

Looking from the window, which forms the central figure in the new design for the New York Architectural Terra-Cotta Company's advertisement (see page xvi) there may be seen the front elevation of the Fifth Avenue Theatre, which is particularly rich in terra-cotta design, examples of which we publish herewith.

The illustration in this advertisement will be changed each month, giving a series of the best examples of recent terra-cotta work which has been executed by this company. Supplementary to the illustration which appears in the advertisement we shall print bits of terra-cotta detail used in the building illustrated.

A FAIENCE MEDALLION, MADONNA AND CHILD,

executed by Andre della Robbia, photographed from the original in the National Museum, Florence, is the illustration chosen by the Atwood Faience Company for their advertisement this month (see page xv). We intend to publish soon some illustrations of work recently executed by this company showing the excellence of their productions.

THE NEW ODD FELLOWS' TEMPLE, PHILADELPHIA,

which is a strikingly beautiful example of brickwork in the lighter shades, is the subject chosen by the Eastern Hydraulic-Press Brick Company for illustration (see page xviii).

THE BROOKLYN STORAGE WAREHOUSE.

A most excellent example of the massive design may be found in the advertisement of The Clinton Metallic Paint Company (see page xxi).

By preserving these illustrations, which are changed each month, one may become possessed of a valuable collection of illustrated brick and terra-cotta work, old and new.

FIREPROOFING.

A Department Conducted in the Interests of Building Construction to Prevent Loss by Fire.

SKELETON CONSTRUCTION.

FIREPROOFING. FOUNDATIONS.

AN article by the writer, published a few months ago in THE BRICKBUILDER, contained some mistakes.

It was stated that the cantilever foundations in the Rand-McNally Building, Burnham & Root, architects, were the first embodiment of that principle in foundations for office buildings; whereas, in fact, the writer (who himself was concerned in the planning of the Manhattan Building) is reminded that the Manhattan preceded the Rand-McNally Building somewhat. When the permit for the former was being applied for, it was found that, owing to the presence in the adjacent basement of boilers which could not be disturbed for the insertion of adequate foundations for the abutting walls of the two buildings, it was necessary to support the side walls of the new building independently of the old foundations. Then it was that the idea occurred to Mr. W. B. Mundie, of Jenney & Mundie, the architects of the Manhattan Building, that the cantilever principle could be used. This, probably, was the first use of the cantilever foundation (March, 1890), and it has been used frequently since in other notable buildings. The Rand-McNally foundations followed so closely after the Manhattan that very likely Mr. Burnham and Mr. Mundie hit upon the happy idea simultaneously and independently.

For a still earlier suggestion, if not application, of the cantilever in foundations, the reader is referred to an extract from a letter to the writer, quoted hereinafter.

It is a mistake if these articles have in any way given an impression that any Chicago man claims to have invented isolated foundations. As one remarks, "They are as old as the art of building." Mr. Frederick Baumann, in a pamphlet, "Foundations," published in 1873, said: "Such isolation of piers has been, however, the exception, not the rule. Its origin is from chance and circumstance, not from logic. I, on the other hand, advance a principle which makes isolated piers the rule in all cases, and continuous foundations the exception." In a recent letter to Mr. Jenney, Mr. Baumann observes that in two particular buildings with continuous foundations he noticed, in 1892, "a going out" of the corner piers, and he says: "In 1853, I made plans for the Marine Bank and decided at once for isolated piers, which were constructed with a happy result. Ever since then I advocated the principle of isolated piers." He says also, that these first foundations were of rubble stone, — "dimension stone at the time was not even dreamt of, till about '55."

Mr. P. B. Wight, kindly answering a question asked by the undersigned, writes as follows concerning isolated foundations: "As used in Chicago office buildings, . . . if meaning thereby foundations with iron rails and beams imbedded in concrete, I will say that I think I did invent them. On this supposition, Mr. Burnham has informed you correctly, for he is my best witness. In explaining how it was, I am obliged to correct one statement you made in your article. I never was aware that Gen. Wm. Sooy Smith was employed as consulting engineer on the Montauk Block. I was employed as consulting architect in connection with Burnham & Root, and it was not until the company that I was organizing had obtained the contract for the hollow-tile floor, arches, and concreting, as well as protecting the columns and girders, in that building, that I resigned my position. In that capacity I made plans for the foundations of the building, which were generally of the pyramidal order, and it was the first building in which the basement was largely sacrificed for that purpose. But finding that this system, allowing the proper offsets in the courses of stone, would carry the foundations for several stacks of vaults above the basement floor, I inserted railroad iron in the course of concrete under these stacks, so as to give very large offsets to the concrete. This was the first use of iron rails for that purpose that I am aware of.

"Part of the walls were on continuous foundations, and where there were large openings in the basement story with iron mullions I inserted double rolled iron beams under them. This I had done eight years before in the American Express Building, on Monroe Street.

"There are other particulars in which the Montauk Block marks a new era in the erection of high buildings. It was on my recommendation that the adjoining building, which had an independent wall, was put on screws during the whole time of the erection of the Montauk Block. These screws were in a continuous row, and rested on the offset of the foundations of the Montauk Block, which now supports both buildings.

"This building does not have brick floor arches, as you state, but all the floors are carried on six-inch flat hollow-tile arches. They are peculiar in this respect, that they are the first hollow-tile arches ever made with walls not more than half an inch thick, and the first ever made of pure fireclay. This marked the era of very light floor construction, which helped to make the erection of very high office buildings possible.

"With regard to the credit due for other valuable inventions used in Chicago buildings, I will add what may be, in some respects, a correction of what you have said on that subject. Mr. Jenney is entitled to the credit of using a complete iron framework sufficient to support all the floors above the first story, independent of the enclosing brickwork, but the Home Insurance Building is not an example of skeleton construction as now understood. In that building the brick piers are built entirely around the cast-iron columns except in the original upper story, where they are covered with tile on the inside. There is no separate and independent lining of hollow tile. The first building in which a complete skeleton wall was built, that I am aware of, was the Phœnix Insurance Building, now the Western Union Telegraph Building, in which the rear wall, or about one hundred lineal feet of it, is a complete skeleton construction, with enamelled brick on the outside, and a hollow tile wall on the inside. Each is supported on its own system of horizontal beams. This was done by Burnham & Root, one year later than the Home Insurance Building, and was the prototype of the court construction of the Rookery.

"Mr. Beman used railroad iron in the foundations that were laid for Marshall Field's building (to a limited extent only, — most of these were pyramidal, dimension stone foundations), where the Woman's Temple now stands, shortly after the Montauk Building was built. These were afterwards taken out when the Temple was built. It was during the litigation between Field and D. Z. Leiter over these foundations that Mr. Jenney gave testimony advocating that the outer wall of such a building could be built on cantilever foundations, which, I think, was the first suggestion of the kind ever made. The best illustrations of this system may be seen not only in the Rand-McNally Block but in the Ellsworth Building, on Dearborn Street, by J. M. Van Osdel.

"I was witness of all that was done at the Home Insurance and Phœnix buildings, for I was manager of the company that did the hollow-tile work on both buildings.

"Yours truly, "P. B. WIGHT.

"P. S. In the *Inland Architect* for March, 1892, you will find a description of my early experience in building foundations in Chicago, the facts of which have never been disputed, — this in Part II. of the series, 'Recent Fireproof Building in Chicago.'"

In this issue of THE BRICKBUILDER are presented selections from the working drawings of the Wyandotte office building of Columbus, Ohio, one of the latest buildings designed by D. H. Burnham & Co.

D. EVERETT WAID,
Chicago.

FIREPROOF FLOOR ARCHES.

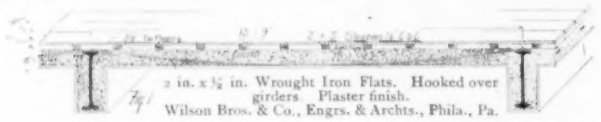
By George Hill, C. E.

PUBLISHED TESTS.

THE first thing that a wise man does, when looking into some new subject, is to ascertain what is the state of the art, and learn as far as possible what has been done by others in the line that he intends to investigate.

We shall, therefore, for a time consider this branch of the subject, briefly summarizing tests which have been made by others in the line of determining the strength or other characteristics of the fireproof floors.

Wilson Arch (*Engineering Record*, May 24, 1890, page 392): This arch is made of concrete and iron, and in the manner indicated in Fig. 1.

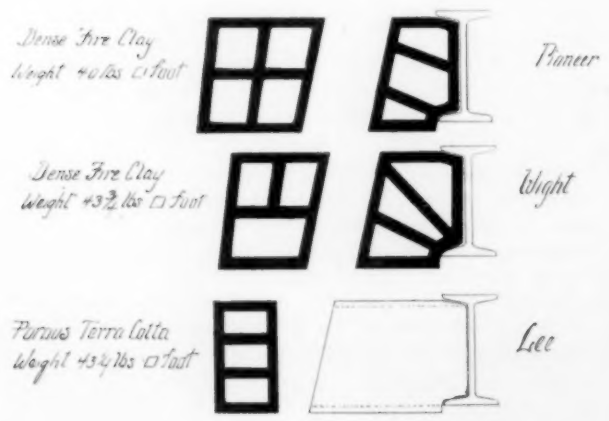


They publish this statement: "The capacity of this floor is not given, but was indicated by two photographs, one showing it sustaining a load of bricks piled over its entire area about three feet high, and another showing it collapsed by a little increase of the load." This would indicate an ultimate strength of about three hundred and seventy-five pounds per square foot, and efficient strength with a factor of safety at ten of about the actual load of the arch. It is quite probable that this was by no means a fair test. It is also probable that the arch had not been constructed a very great while, and that consequently the concrete had not had an opportunity to thoroughly set. Generally it will be seen that the depth of the sag to the strap iron is not such as to fully develop its strength in an economical manner. The general principle of this arch is that of having metal supply the tensile strength, while the concrete supplies the compressive strength. When it is desired to put in a flush ceiling a similar construction of much less depth is applied to the lower flange of the beams; this being so much less in depth is, of course, likely to somewhat sag.

DENVER TEST.

These tests made at Denver, Col., in December, 1890, by Messrs. Andrews, Jacques and Rantoul, and published in *The American Architect* for March 24, 1891, are so widely known, and were so carefully prosecuted, that they have come to be always thought of whenever we think of the matter of tests of fireproof floor arches. The information in detail concerning these tests has also been so wisely scattered that it is unnecessary at this day to go into it. It will be recalled that the arches were of three makes, the Pioneers, the Wight, and the Lee, and of section similar to the sketches of Fig. 2.

Fig. 2



A glance will show that the area under compression in these various arches is varying in amount, and if we desire to know which is the best we should know what the sectional area of the working section is in each case. This has been entirely omitted from the records of the test as published, and cannot therefore be ascertained. All that we know concerning the arches is to be obtained from the photographs and sketches in the report. The arches were tested, *first*, by still load; *second*, by shock; *third*, by fire and water; *fourth*, by continuous fire. These tests were each applied to all of the arches, and the results are thus summarized in the report as published in the *American Architect*.

"TEST A.

"*Still-load Test.* — The test for still load was made on the arches marked, A-1, A-2, and A-3. It was decided to apply the weight to the arch by piling up pig-iron on a space three feet square in the middle of the arch. A curbing, or box without either top or bottom, three feet square and four inches deep, was placed on the middle of each arch, and this box was filled up with dry sand, and on the sand pig-iron was laid, and steadily and continuously applied without shocks until the arch broke. The weight of the box was 82 pounds, and the weight of the sand inside the box was 350 pounds, making a weight of 432 pounds on each arch, besides the weight of the pig-iron.

"*Arch A*-1. [Built by the Pioneer Fireproof Construction Company.] The pig-iron was placed on this arch when it was not quite four days old. The pig-iron was weighed before placing on the arch, and it was carefully put on, so as to avoid shocking the arch. When a weight of 1,917 pounds of pig-iron had been placed on the arch the deflection was measured, and found to be .01 of a foot. When a weight of 4,000 pounds had been placed on the arch the deflection was found to be .012 of a foot. When a weight of 5,429 pounds of pig-iron had been placed on the arch the arch broke suddenly and without warning, the final deflection not being measured. The arch broke from beam to beam, the whole arch coming out except the side of the abutment pieces on the right-hand beam, which were still held to the beam by the mortar. *The right-hand side seems to have given way first, apparently because of the failure of the right-hand abutment pieces.*[1] The left-hand abutment pieces dropped on the ground, whole and unbroken. The mortar seemed to be very good and quite hard for four-days-old mortar. The failure of the arch does not seem to have been caused in the slightest degree by the mortar, *as the failure was, beyond a doubt, in the angles of the right-hand abutment pieces.*

"*Arch A*-2 [built by Thomas A. Lee] was next tested for still load. This arch was prepared just the same as the arch A-1, with the curb and sand, before the pig-iron was applied to it. This arch was, practically, of the same age as the arch A-1. When a weight of 2,050 pounds of pig-iron had been applied to the arch the deflection was measured, and found to be .015 of a foot. A weight of 4,337 pounds produced a deflection of .016 of a foot; 5,965 pounds produced a deflection of .024 of a foot; 7,981 pounds was sustained for twenty-five minutes while a scaffolding was being erected around the arch; 8,997 pounds produced a deflection of .038 of a foot; 10,284 pounds produced a deflection of .04 of a foot; 11,532 pounds was carried for thirty minutes while scaffolding was being raised; 12,245 pounds caused a side deflection in the beams of about three eighths of an inch in the length of the arch; 13,325 pounds caused a deflection of .055 of a foot. When 14,494 pounds had been applied a photograph was taken; 15,145 pounds produced a deflection of arch of .065 of a foot, the deflection of beams having increased to about one half an inch. The loading of this arch stopped at this point, as it was feared that the pile of pig-iron would topple over and injure the workmen. This load of 15,145 pounds was left on the arch for two hours, when the load was removed, and the same block of wood which was used in the shock test was dropped on this arch, A-2, from a height of ten feet above the arch. The arch broke at the third drop. The load 15,145 pounds opened the joint at the bottom

[1] Italics ours.

of the key about one quarter of an inch in the entire length of the arch, and opened the joint at the upper edge of the skew-backs at the sides near the top. When the load was removed the beams resumed their straightness, and the arch recovered from its deflection and was apparently uninjured in any respect.

"*Arch A*-3. [Built by the Wight Fireproofing Company.] The box and the sand were prepared on this arch just the same as for arches A-1 and A-2. The age of the arch was, practically, the same as the others. 2,358 pounds of pig-iron produced no deflection; 3,073 pounds produced a deflection of .008 of a foot; 6,012 pounds produced a deflection of .017; 8,024 pounds produced a deflection of .018. When 8,574 pounds of pig-iron had been placed upon this arch the arch gave way suddenly without warning, clearing out the whole arch from beam to beam, falling vertically without disturbing the pig-iron and *apparently failing in the abutment pieces, both abutments being sheared right off, the failure seeming to be in the angles of the abutment pieces*.

"TEST B.

"This was a test to show the comparative resistance of the different arches to shocks or blows. The arches tested were marked B-4, B-5, and B-6. The blows were given the arches by dropping upon them a piece of Oregon pine 12" square and 4' long. The weight of this stick was 134 pounds. At the request of the Pioneer Company, the specifications were altered for this test, so that instead of starting with a drop from a distance of twelve feet, as specified, the first blow was delivered from a height of six feet, the height to be gradually increased. This change was agreed to by the other competitors. The tops of the arches were protected by covering them with one and one half inches of loose, dry sand.

"*Arch B*-4. [Built by the Pioneer Fireproofing Company for the dropping test.] The 12" x 12' stick 4 long, weighing 134 pounds, was dropped on this arch from a height of six feet, the stick being in the middle of the arch and at right angles to the beams. At the first blow the whole arch was shattered to pieces and utterly destroyed, not a particle of it remaining on the beams.

"*Arch B*-5. [Built by T. A. Lee for the dropping test.] The same stick was used here, and the first drop from a height of six feet was at right angles to the beams. The second drop, parallel to the beams, from a height of six feet, broke off the bottom web of one tile. Third drop, right angles to the beams, from a height of six feet. Fourth drop, parallel to the beams, from a height of six feet, broke off the bottoms of two tiles. Fifth drop, from a height of eight feet, at right angles to the beams, broke off part of rear rib. Sixth drop, from a height of eight feet, parallel to the beams, broke the key on the rear course, the entire tile falling out. Seventh drop, from a height of eight feet, at right angles to the beams, the whole rear course dropped out. Eighth drop, from a height of eight feet, parallel to the beams, front key tile broke. Ninth drop, from a height of eight feet, at right angles to the beams, punched a hole clear through in the middle of the arch, three tiles out, — one a key tile. The top of the arch was photographed after this blow. Tenth drop, from a height of eight feet, parallel to the beams, four whole ribs gone entirely. Eleventh drop, from a height of eight feet, parallel to the beams, the arch dropped.

"*Arch B*-6. [Built by the Wight Fireproofing Company for the dropping test.] The same stick was used here, and the first drop from a height of six feet, at right angles to the beams, caused the arch to fall. *The skew-backs in this arch gave out, being broken to pieces*. The intermediate and key tiles seemed to stand first rate; only one intermediate tile broke in the whole arch; it was a tile next to the abutment. All the rest of the intermediate and key tiles held their shape and simply dropped to the ground unbroken.

"*C*-7. [Built by the Pioneer Company for the fire-and-water test.] After the fires first built were drawn, pieces of the lower web fell from several tiles,— not all at once, but at intervals. This was probably due to the shock of the impact tests, which were carried on beside this arch, though the shock felt by the arch must have been very slight after transmission through a number of feet of earth. Started fires of kindlings at 3.25 P. M., Friday, and started use of Rouse coal. At 3.50 there was a very hot coal fire under the arch. At 5 the temperature of the arch was 1300°, and the first stream of water was applied for two minutes. The bottom web fell from two tiles. The fire was at once started again, and at 5.47 the temperature had risen to 1650°, and a second stream applied, this time for four minutes, with the result of several more pieces of the bottom web falling and the practical destruction of one whole tile.

"A considerable time was required to again raise the temperature of the arch to a desirable point. This, we think, was due to leakage of air through the partly destroyed arch. However, at 7.21 the temperature was 1350°, and the third and last water test was applied, and destroyed the arch so completely that no further test was deemed necessary. The bricks over the centre of the arch fell about two inches, but the mass of the load formed an arch resting on the skew-backs, and became self-supporting. One entire row of tile was destroyed, and the majority of the remainder were broken and partially fallen, so the arch was considered a ruin and abandoned. After the front of the brick setting was removed it was found that the arch, in falling, had lodged on the setting, and was thus prevented from falling completely. The final condition of the arch, as seen after part of the setting was removed, was as follows: —

"The skew-backs were intact on both sides; the rib of the intermediate next to skew-backs remained in each tile on the skew-back, showing that the mortar had not given way. Both intermediates to left of the key in the two centre courses were wholly destroyed, as was the intermediate next to the skew-back in the front course. The greater part of the intermediates next to the skew-backs for three courses on the right of the key had fallen, and the front key tile was partially destroyed.

"*C*-8. [Built by Thomas A. Lee for the fire-and-water test.] Fire of kindlings and coal was started at 3.25, and an excellent fire was burning at 3.50. About 4, the lower web of a tile next to the key in the course next the rear fell out without apparent cause. The arch was at a temperature of 1450° at 4.57, when the first stream of water was applied for two minutes. No change in the arch was apparent. The fire was started again at once, and at 5.42, the temperature being 1230°, water was again applied, this time for four minutes. No tile fell. This alternation of fire and water was continued, and the water was applied for four minutes at each of the following times: 7.20, 8.17, 9.49 P. M., 1.49, 6.50, 8.15, 10.03, 11.53 A. M., 2.30 P. M. — eleven times in all. The temperature was generally above 1200°. At 9.49 P. M., Friday, a piece of the web of the key of the fourth course of tile came down, but, with the exception of this piece and the one previously mentioned, the arch remained intact to the end. A longer time was required to raise the arch to a high temperature after each wetting. On this account we were unable to apply the water test as often as to C-9. We presume this was due to the large amount of water that this tile could absorb, which had to be evaporated before the tile could become hot. This is proved by experiments made by us, which give the following moisture-absorbing powers for the material for the various arches in percentages of weight of water take-up.

C-7, Pioneer	5.7 per cent.
C-8, Lee	32.5 "
C-9, Wight	5.5 "

"At the end of the test, about twenty-three hours after the start, the arch was practically whole. The only tiles broken were the key and intermediate next to the key on the left of the course next to the rear. The front had been removed to allow light to enter, but the sides were still intact.

"*C*-9. [Built by the Wight Company for the fire-and-water test.] Fire was started under this arch at 3.25 P. M., and the tile was at a temperature of 1450° at 4.53. A stream of water was then applied for two minutes, without result, which was also the case when the water was applied for the second time at 5.38, the temperature

being the same as before. The third trial at 7.00 brought down the bottom webs of the intermediate tiles on both sides of the keys. The water was applied for four minutes in this and succeeding trials. At 7.49 the temperature, when the water was applied, was 1320°, and the bottom webs of two more tiles on left of key and the bottom web of an intermediate tile on each side next to the skew-backs fell. After the water was applied at 8.50 every tile was broken in its bottom web, and a sagging of the load of brick was noticed. The upper web of the tile seemed to be solid. At 9.43, 10.34 P. M., 1.49, 6.15, 7.00, 8.15, 9.57, 11.05 A. M., 12.32 and 2.30 P. M. (fourteen times in all), we continued to apply the stream, with the same result of knocking down a few pieces of the tile each time. No particular change was seen in the load.

"When the test was stopped the lower web was completely gone from every tile and much of the vertical and intermediate ribs. The upper web seemed to be completely whole.

"The total combustible burned under these arches was as follows: —

C-7	552 lbs.
C-8	1,466 "
C-9	1,538 "

"*Continuous-fire test.*

"Under D-10, D-11, and D-12 the fires were started at 3.25 P. M., and were first fed with Rouse coal to the extent of 300 lbs. each, after which anthracite was used to the end of the test. The fires were forced as much as possible, and the arches were white hot for nearly the whole time. The amount of coal burned in D-11 was less than in the others, but it does not necessarily follow that the heat was any less. In fact, the arch presented a much hotter appearance than D-10 or D-12, and the fire was forced as much as possible. The position of the dampers was not easily regulated, and while the more open the damper the greater the amount of coal burned, there was also a much greater loss of heat through the chimney. We consider that D-11 was tested as severely as the other two. Such temperature measurements as we were able to take showed as high temperatures as were reached in D-10 or D-12.

"All the arches lasted through the test, which ended at 3.25, Saturday, making the total length of the test twenty-four hours. No tile fell from either of them, and until the furnace settings were removed they were apparently in as good order as when first fired, though the bottom webs of each showed numerous cracks and slightly open joints.

"The total combustible burned under the arches submitted to the continuous-fire test was: —

D-10	1,916 lbs.	80 lbs. per hour.
D-11	1,529 "	64 " " "
D-12	1,942 "	81 " " "

"The loads of brick were left on the arches until Monday morning, Dec. 22, when we proceeded to remove the walls of the furnace settings under the I-beams, care being taken not to jar the arches while the brick was being removed.

"*C-7.* This was a wreck, but it was found that the intermediate tile in the front course to the left of the key in falling had lodged on the furnace setting and supported the rest of the arch and the few bricks from the load that had fallen with the arch, and when the bricks of the setting were removed the whole arch fell.

"*C-8.* The whole setting was removed without any deflection of the arch, which remained entirely supported by the I-beams, as originally constructed. The bricks of the load were removed from the sides and piled in the centre to concentrate the load, but without effect on the arch.

"*C-9.* This whole arch was seen to be be cracked in all directions before the setting was removed, and when this was done it fell at once.

"*D-10.* After taking out the front and side walls, the arch was seen to be cracked from top to bottom in the ribs, the bottom webs had fallen from two tiles, and the right skew-back front gave way, the arch settled but held until the back was removed, when it fell entirely.

"*D-11.* The entire setting wa removed without any change in the arch, and the removal of the outside bricks of its load to the centre had no effect. The right front skew-back was cracked in the lower web near the I-beam.

"*D-12.* One bottom web fell out while the setting of D-11 was being removed, and the whole arch fell when its setting was taken down.

"Arches C-7, C-9, D-10, D-12 would doubtless have fallen during the test had the furnace settings been differently arranged. The interior of the setting was smaller than the arch itself, so the outer edges of the arches rested on the settings, and so received support.

"At 3.45 P. M., Monday, arch C-8 was still intact with its load. The bricks were then removed from it, and, having covered it with a layer of sand, we subjected it to a series of blows from the timber used in the previous impact tests. The first blow was at right angles to the I-beams and the drop was six feet. Several loose pieces from the lower webs of centre tiles fell, which we consider to be the extent of the tile affected by the heat. The second, third, and fourth blows were alternately parallel and at right angles to the I-beams and the drop was six feet. A few loose pieces of small size fell each time. The height of drop was increased to eight feet and the blows were alternated in direction, as before. In the fifth, sixth, and seventh blows the lower middle webs began to be fractured and a hole was broken through at the back in the centre of the arch. The ninth blow, across the arch, knocked out a hole two by three feet from the centre of the arch, but two more blows along the arch were required to completely demolish it, but the arch was still solid.

"The load on D-11 was left on it until 5 P. M., Monday, when the bricks were taken from each side and piled on the centre, so as to concentrate the load on the three centre tiles, and was left in this condition until 9 A. M., Tuesday. It was then noticed that the joints along the middle of the bottom were slightly open, and the I-beams were slightly sprung apart. Bricks were then piled upon the load until there was a weight of 12,500 pounds resting on an area of the centre of the arch, measuring thirty-six inches across the arch by fifty inches along it.

"It was deemed unsafe to the men to build the load higher, since it was very unstable and likely to topple over. The arch, however, was apparently sound, and its deflection did not exceed five eighths of an inch.

"The following data, obtained from experiments made by us upon samples of the different tiling entering into the construction of these arches, have their value: —

Specific Gravity.

C-7 equals 2.40
C-8 " 1.99
C-9 " 2.44

Specific Heat,

or amount of heat required to raise equal weights through same range of temperature: —

C-7 equals 0.19
C-8 " 0.18
C-9 " 0.20

or, what is more desirable in this case, the

Specific Heat per Unit Volume.

C-7 equals 0.456
C-8 " 0.358
C-9 " 0.488"

(*To be continued.*)

If you have not seen the little booklet entitled "Our Maiden Speech," issued by the Akron Vitrified Pressed Brick Company, Akron, Ohio, you had better send for one. It is original and to the point.

MORTARS AND CONCRETES.

A Department devoted to Advanced Methods of using CEMENTS and LIMES in Building Construction.

CONCRETES, CEMENTS, AND MORTARS: OLD AND NEW.

(*Continued.*)

HYDRAULIC limes are seldom used in this country, owing to the abundance of hydraulic cements, which are more economical in many ways. Hydraulic limes contain from twenty-five to thirty-five per cent of impurities. They slake slowly, with a slight rise of temperature and an increase in bulk of nearly one third; they will set under water in from one to twenty days. The mortars made with hydraulic lime require to be mixed the same way as common lime-mortar, and in about the same proportions. Use clean water and sharp pit sand.

Hydraulic cements are made from limestones containing from forty to sixty per cent of impurities. These stones are calcined, and then ground fine, when they are ready for use. They do not slake at all, so that their bulk and temperature remain the same while mixing and setting, and they may therefore be used *neat* in a pure state. These cements set quickly either under water or exposed to the air. Deposits of natural cement stone are found and worked in the United States and Canada, principally in New York, Pennsylvania, Virginia, and on the banks of the Welland Canal, Canada. The principal deposit is found near the town of Rosendale, Ulster Co., N. Y., near the Hudson River, and the name of the town gave the name to the cement, which is now known from Maine to Alaska, and Hudson's Bay to Key West. It was first brought into use about 1823, during the building of the Delaware and Hudson Canal. Now, the average output amounts to about two million pounds annually.

A similar cement is made in Utica, another in Akron, N. Y., and still another in Milwaukee, Wis., and in Louisville, Kansas City, Kensington, Trinidad, and Thorald, Ont.

The best Rosendale cement varies in weight from fifty to fifty-six pounds per cubic foot, the hardest burned and finest ground being the heaviest. Ulster County cement averages three hundred pounds net per barrel; while Utica, Akron, Louisville, and Milwaukee weigh only two hundred and sixty-five pounds per barrel net.

The Rosendale quarries or ledges are of some twenty or more different strata, and vary from a cement that sets in three minutes to one that takes an hour and a half to set. The best cement made at these quarries is a mixture of several strata in the proper proportions. The following analysis shows the variations occurring in the different strata of the Rosendale quarries, which is quoted from an official authority: —

	PER CENT.	PER CENT.
Silica, clay, and insoluble silicates . . .	11.10	39.47
Alumina ($Al_2 O_3$)	2.34	7.50
Sesquioxide of iron (Fez. O_3)	0.76	5.33
Carbonate of lime (Ca CO_3)	28.48	46.00
Carbonate of Magnesia (Mg. CO_3) . . .	14.48	39.04
Potassium and sodium chlorides . . .	1.68	7.42

According to one authority, Rosendale cements may be tested as follows: "Take two handfuls of cement and mix with as little water as will make the mass into a stiff paste. Make into two little cakes; place one of these in water, expose the other to the air. If the cake exposed to the air dries of a light color without any definite cracks, and the one immersed sets with a darker color and free from cracks or fracture, the cement may be considered good." Another test to ascertain the soundness of the cement, which is the property of not swelling or shrinking, or cracking in setting, is to place some of the mortar in a glass tube or vial, or in an ordinary swelled lamp chimney, and fill with water. If the glass breaks, the cement expands, and should be rejected if intended for wet places.

Gilmore states the adhesion of Rosendale cement to the front bricks, after twenty-eight days, when pure, to be thirty pounds, and mixed with one and two parts of sand, sixteen and twelve pounds.

Desmith found the Virginia cements in pure state, after thirty days' exposure, one hundred and seventy to two hundred and fifty pounds tensile strength per square inch, which increased in eleven months to three hundred and sixteen and three hundred and eighty-one pounds. Mixed with equal portions of sand, he obtained from one hundred and sixteen to one hundred and thirty-five pounds, and one hundred and eighty to one hundred and ninety after eleven months' exposure.

Clarke reports the tensile strength of Rosendale cements, pure, after one and twelve months, as one hundred and forty-five and two hundred and ninety pounds.

Mixed, one and one, after one and twelve months, 116 and 259 pounds.

Mixed, one to two, after one and twelve months, 60 and 180 pounds.

Mixed, one to three, after one and twelve months, 35 and 121 pounds.

The proportion of tensile to compressive strength averages probably, after one month, one to four; and rises after two years to probably one to six. The specifications of the engineer's department of the District of Columbia require seven days after mixture, for *neat*, natural cement, ninety-five pounds, and for mixture of one and two parts of sand, fifty-six and twenty-two pounds tensile strength per square inch.

As a general rule, cements set and harden better under water than when exposed to air, although, if the temperature for the first few days does not exceed 60° F., there seems to be no appreciable difference; with a higher temperature, the cement dries instead of setting, and thus loses much of its strength. It attains its maximum hardness only after a lapse of many years, although after the first year the increase is very slight.

Sand retards the setting of all cements, and weakens Portland in about the following proportions: —

1 pint sand to 1 pint cement gives $\frac{1}{2}$ strength of pure cement.
2 " " " 1 " " " $\frac{1}{3}$ " " " "
3 " " " 1 " " " $\frac{1}{4}$ " " " "
4 " " " 1 " " " $\frac{1}{5}$ " " " "
5 " " " 1 " " " $\frac{1}{6}$ " " " "

Rosendale being reduced somewhat less.

The following remarks and directions, which have been gleaned from standard authorities on the mixing and using of cements, may not be out of place at this juncture: All cements of good quality manufactured in the United States or Canada, when mixed in proportion of two of sand to one of cement, will give a mortar sufficiently strong for most engineering purposes. A good Portland, like the Dyckerhoff, the Boulogne, or the English Imperial, will give an equally strong mortar with from three to four parts of sand; and, although costing much more than our native cements, may still be, in some cases, the more economical.

All sand used with mortars or cements of any sort whatever should be clean, sharp, and coarse. Fine sand, and especially water-worn sand, delays the setting, and deteriorates the strength of cements. Damp sand should be well mixed before the dry cement is put with it. Mix both well together while dry. Use no water until just before the cement paste is required.

The larger the proportion of cement, the stronger will be the result. For cisterns and works under water, the best proportions are one and one. For floors and walks, the cement should be increased

near the surface. Use no more water in mixing than is absolutely necessary.

Whenever concrete is used under water, see that there is no ripple or current, as the water should be perfectly still. In still water, cement will harden quicker than in air, and when kept in water will be stronger than when kept exposed to the air.

Cements that set quickly in air harden slowly under water, and should not be used in such positions.

In putting down cellar floors of concrete, the material should be dampened, and then tamped down with a block of wood similar to a paving hammer, then finish off with a trowel. When required, finish off with neat cement, and if well done the floor will be as hard and as compact as natural stone.

All good cements require to be used immediately after mixing, or they will set on the mortar board, and become useless. Poor cements may stand longer, as they do not set so quickly.

Buildings, either brick or stone, are, in a measure, cyclone proof if the mortar used is composed of good cement. Chimneys laid in mortar of this sort never blow down, and while the extra cost is not great, the value of the buildings is much enhanced.

Cement may also be mixed with common lime mortar for plastering with advantage. Good cements may be stored away for years in barrels or other tight vehicles, and, if kept free from moisture, are not injured the slightest bit.

Cold seems merely to retard the action of setting, and if the mortar thaws equally no serious harm results, so that, if necessary, work may be continued when the temperature is below zero, care being taken that the mortar thaws equally on both sides of the wall. Do not heat the sand, cement, or water above blood warmth.

In every important work each lot of cement should be tested before being accepted, and the superintendent should have the power to reject any cement he might think not up to the standard.

A careful adherence to the foregoing hints will, almost in every case, produce satisfactory results.

FRED T. HODGSON, C. E.

FINENESS OF PORTLAND CEMENT.

THE writer does not think that Mr. Hodgson, in his valuable article on "Cements, Old and New," has made clear to the reader the relative value of weight to fineness in Portland cements. The old advocates of weight were right, in a measure. To get the best results from a Portland cement composition, the clinker must not only be ground fine but must be burned hard, which makes the cement heavy. If the cement is not the product of heavy clinker the fineness availeth nothing. Of two Portland cements of equal fineness the heaviest one will invariably make the strongest mortar.

The principal reason the English manufacturers lost their grip on this market was due to the question of fineness. Until quite recently, they stubbornly refused to meet the importer's demand, and furnish a hard-burned cement, ground fine enough to meet the requirements of the engineering profession in this country.

To the German manufacturers is due the credit of educating this country up to requiring a finely ground cement, but it must be said to the credit of the American Portland cement manufacturers that they have been prompt in meeting this issue, and to-day the American Portland cements are, on an average, the finest ground cements on this market, and for the past three years the American and German Portland cements have supplied practically all the work which required hard-burned, finely ground cement, whereas ten years ago, when the requirements were more lax than at present, the English Portland cements supplied the bulk of it.

No better illustration of the fineness of Portland cements can be found than the report of the Engineering Commission, District of Columbia, for the year ending June 30, 1894, which shows that the

Average of six German Portlands tested was 92.8 per cent fine on a No. 100 sieve.
" " five American " " " 93.1 " " " " " " " "
" " two English " " " 83.0 " " " " " " " "

It must be borne in mind, however, that this matter of fine grinding very materially increases the cost of manufacture, and this means an increased selling price.

That more sand can be used with the finely ground cement is true, which is the reason some specifications call for 90 to 95 per cent fine on a No. 100 sieve, instead of 90 to 95 per cent on a No. 50 sieve, as was the custom a few years ago. But the addition of sand has a limit. The writer questions whether any competent engineer will allow the use of a larger proportion of sand than three or four to one, while the proportion of crushed stone, etc., will be influenced by the size and quality.

A cement may be strong enough to stand a larger percentage of sand, yet theoretically, in any cement work, all the voids are expected to be filled; and in a sand mixture larger than four to one, the writer is sure that there will not be sufficient cement to do this, no matter how fine the cement is ground. This fact limits the quantity of sand and, without being able to increase this quantity, there is no necessity of carrying this matter of fine grinding to extremes.

WM. G. HARTRANFT.

PHILADELPHIA, Jan. 1, 1895.

AS an instance of the absurd specifications made by architects of excellent standing, in regard to the use of concrete, the writer had occasion to visit a large building, recently constructed, in which the floors are of the I-beam and concrete-arch type. The span of the arch is not over six feet, but it seemed necessary to use a concrete arch some thirteen inches thick at the crown. The concrete itself was of so poor quality that it could be readily scraped up with an umbrella. It was abominably poor stuff, and although large quantities of materials were used, the result was far short of a good piece of work. It was downright poor. The arches were in many places cracked from end to end, and the load on the beams was far in excess of requirements. With one quarter of the quantities of proper material, and at very much less cost, these floors could have been made strong, and capable of great loads, whereas now they are barely capable of acting as a filling between beams.

This simply shows the absurd and downright stupid manner in which concrete is handled, even by those who stand high in the professional ranks; and until there is a more intelligent conception of its qualities, there is going to be a lasting predjudice that is nothing less than injustice to a splendid building material.

ROSS F. TUCKER.

COMPOSITION OF MORTAR.

THE Austrian Society of Engineers recently conducted experiments with a view to determining the composition of mortar best adapted to work, and to remain in permanent and effective condition when mixed and laid during freezing weather. The experiments were made first with brick masonry, two kinds of stone being used for the purpose; everything was dry and free from snow and ice, and the mortar was mixed as stiff as possible; the limes and cements were all tested in the municipal experimental station, according to the established and reliable system of the society. The conclusions of the investigating committee, as briefly summarized, are, that in brick masonry laid in frosty weather mortars into which any part of lime enters should not be used; Roman cement mortars behave fairly well under such conditions, and Portland cement mortars give good results. The use of warm water showed somewhat more satisfactory work, and salt materially increased resistance to frost. With rubble masonry, using either sandstone or limestone, lime mortar was entirely out of place, and Roman cement mortar gave unsatisfactory work unless mixed with salt; the Portland cement mortar behaved well, especially with the addition of salt Under all the circumstances presented by these various tests, and the character of the results obtained, the final recommendation of the committee is, in laying brick or rubble masonry in winter, to use only Portland cement mortar, mixed with salt if possible. — *From British Clayworker.*

AMERICAN CEMENTS.

III.

IN order to arrive at even a fair understanding of the true nature of American rock cements, and to be able to judge accurately, or even approximately, as to the position these cements occupy in the world, and the relations they bear to the natural and artificial cements of Europe, together with the time of their first fabrication, and the uses that were made of them, and to fairly comprehend the state of the art from its earliest inception until the present time, it will be necessary to take a glance at the history of this important building material, even though it be a cursory one.

It seems to be conceded by all European authorities that John Smeaton, C. E., of England, was the first to discover the source of hydraulicity in certain limestones. The discovery was made in the year 1756, while casting about for a reliable mortar to be used in the construction of the Eddystone Lighthouse. It appears that prior to that date nothing was known as to the hydraulic character of the impure limestones of the blue lias formation which extends through several counties in England.

In the year named, Smeaton discovered, during the course of many experiments, that the cause of the hydraulicity of a limestone was due to the presence of clay in the stone.

Pasley, in the preface to his work, dated Sept. 17, 1838, says of Smeaton that "he was the first who discovered, in or soon after the year 1756, that the real cause of the water-acting properties of limes and cements consisted in a combination of clay with the carbonate of lime, in consequence of having ascertained by a very simple sort of chemical analysis, that there was a proportion of the former ingredient in all the natural limestones which, on being calcined, developed that highly important quality, without which, walls exposed to water go to pieces, and those exposed to air and weather only are comparatively of inferior strength.

"By this memorable discovery, Smeaton overset the prejudices of more than two thousand years, adopted by all writers, from Vitruvius in ancient Rome to Belidor in France, and Semple in this country (England), who agreed in maintaining that the superiority of lime consisted in the hardness and whiteness of the stone, the former of which may or may not be accompanied by water-setting or powerful cementing properties, and the latter of which is absolutely incompatible with them.

"The new principle laid down by Smeaton, the truth of which has recently been admitted by the most enlightened chemists and engineers of Europe, was the basis of the attempts, by Dr. John at Berlin and M. Vicat (the engineer) in France, to form an artificial water lime or hydraulic lime in 1818 and of mine to form an artificial water cement at Chatham in 1826, to which I was led by the perusal of Smeaton's observations, without knowing anything of the previous labors of these gentlemen on the Continent, or of Mr. Frost, the acknowledged imitator of M. Vicat in this country."

In a work on "Hydraulic Mortars," published at Leipzig in 1869, by Dr. Michaelis, the following passage occurs: "A century has elapsed since the celebrated Smeaton completed the building of the Eddystone Lighthouse. Not only to sailors, but to the whole human race is the lighthouse a token of useful work, a light in a dark night.

"In a scientific point of view, it has illuminated the darkness of almost two thousand years. The errors which descended to us from the Romans, and which were made by such an excellent author as Belidor, were dispersed. The Eddystone Lighthouse is the foundation upon which our knowledge of hydraulic mortars has been erected, and it is the chief pillar of our architecture.

"Smeaton freed us from the fetters of tradition by showing us that the purest and hardest limestone is not the best, at least for hydraulic purposes, and that the cause of hydraulicity must be sought for in the argillaceous admixture.

"It was a long time before men of science confirmed this statement of the English engineer, or corrected the ideas on the hardening of hydraulic mortars, which were then necessarily confused on account of the imperfect state of chemistry at that time. How could science subsequently keep pace with practical progress? For even at present, though we have possessed for about half a century the most excellent hydraulic mortars, the hardening process is not yet completely explained."

These extracts from eminent authorities on hydraulic cement may be taken as substantial evidence that Smeaton was the first, not to discover, as claimed by these and other writers, but to rediscover the lost art of cement fabrication. There is no doubt whatever but that the ancients thoroughly understood the value of impure limestones for hydraulic cementing purposes.

The fact is, that the history of natural rock cement reaches so far back into the early ages that it is impossible to learn precisely the date of its first fabrication. But we do know that the ancient Egyptians made natural cement four thousand years ago which would set and harden under water. The Romans over two thousand years ago made most excellent natural cement, and used it in enormous quantities for sewers, water pipes, bathing fountains, piers, breakwaters, aqueducts, etc. Prior to this time, an aqueduct over seventy miles in length was built at the ancient city of Carthage. At one place it was carried across a valley on arches over one hundred feet high, and there were one thousand arches in line. In its construction an immense quantity of natural hydraulic cement was used. Some of these arches are still standing. At one point where the arches were highest a single piece over one hundred feet in length has fallen from the top down upon the rocks below. It still lies there intact, unbroken, an excellent illustration of the toughness and tenacity of natural rock cement.

In many places in Mexico and Peru natural rock cement was used so long ago in stone masonry that the stones themselves are worn away, leaving the cement mortar projecting from the joints. During the winter of 1892, while some excavations were being made in the city of London, England, for railway purposes, the workmen came upon a heavy mass of natural cement concrete laid over eight hundred years ago.

Owing to the proximity of buildings, it could not be blasted out, and men were set to work to cut it out with chisels and hammers, and the concrete was so hard as to turn the best steel that could be obtained.

Writers on the subject of Hydraulic Cements, used by the ancients, and especially that used by the Romans, have without exception asserted that their hydraulic cement was made by a mechanical mixture of fat lime and pozzuolana.

It is inconceivable that such an absurd fallacy could obtain, and prevail throughout all the centuries from the time of Vitruvius, a Roman architect, who, it is asserted, served as a military engineer under Cæsar and Augustus, down to the time of Smeaton, in 1756, and still more absurd that it should be handed down from Smeaton's time to the present day without contradiction, when the experiments made by Smeaton, and published by him, utterly contradict such a theory.

G. R. Burnell, C. E., of London, in his work on "Limes, Cements, and Mortars, 1868," referring to Smeaton, says: "The results he arrived at were very remarkable, not only for their practical utility but also as an illustration of the ease with which a very acute observer may stop short on this side of the attainment of a great truth. Smeaton found that the commonly received opinion that the hardest stones gave the best limes was only true as far as regarded each quality considered by itself. That is to say, that of limes not fit to be used as water cements, those made of the hardest stones were the best for certain uses in the air, but that, whether obtained from the hardest marbles or the softest chalk, such limes were equally useless when employed under water. He found that all the limes which could set under water were obtained from the calcination of such limestones as contained a large portion of clay in their composition.

"His experiments led him to use for the important work of the lighthouse a cement compounded of blue lias hydraulic lime from

Aberthaw, and of pozzuolana brought from Civita Vecchia, near Rome.

"Even at the present day, it would be diffiucIt to employ a better material than this, excepting that the price would insure a preference to the Roman cement, then unknown."

URIAH CUMMINGS.

(*To be continued.*)

CONCRETE IN COLD CLIMATES.

ON THE WEATHERING OF CONCRETE SURFACES AND CEMENT STUCCOS.

A GREAT deal of inquiry has been made of late, in view of the increased use of concrete in building construction, as to its ability to resist the action of severe climatic changes in cold localities.

In order to present some testimony on the subject, some facts have been gathered together and are here presented for the benefit of any who may be sceptical as to the weathering of concrete surfaces.

It is to be understood that in speaking of concrete we mean a good concrete, made of good material and properly handled.

It is not to be supposed that the cheap mixtures of soft materials that unfortunately pass often for concrete is to be here considered, for no one could expect that to stand anything.

Neither are we to consider the great works in concrete that were erected in Southern Europe a thousand years ago and which are to-day as strong as ever, nor yet the great buildings and structures of all kinds that have been carried out in California, in Florida, and the warmer portions of America. Every one knows of the wonderful enduring quality of concrete in those localities.

But the evidence to be brought forward will concern works in cold and frosty climates, where the disintegrating action of weather is most destructive.

In Northern Europe, particularly in Norway, Germany, Austria, England, and France, concrete has been in universal use for scores of years. It is recognized as a material to replace brick and stone not only in massive foundations and submarine works that could not be constructed in any other material, but in delicate mouldings and fine artificial stone, and in masonry walls that have to withstand the actions of the sea, as in the Eddystone Lighthouse and the wearing and chafing of ships in the great docks of Hamburg, Havre, Liverpool, and the new Manchester Canal. Again in inland work, in bridges of all kinds which have to sustain the uncertain strains of heavy traffic, concrete has done remarkable work in the most exposed localities,—in Switzerland and Hungary, Dresden and Würtemberg, at Ingolstadt, besides seventy-five or eighty other bridges built under the Monier system throughout Austria and Germany. Moreover, in all these countries everywhere concrete is used in the walls of dwellings and buildings of every kind and description, all of which bear witness to the unquestioned confidence with which the material is used.

In the cold sections of our own country and in Canada concrete has been extensively used, although it has not yet come into the universal use that it has across the water. This may be attributed to the lack of cement, which until recent years has been nearly all imported. In Halifax there are large docks and other extensive works that not only have to withstand the weather but must endure the wearing of heavy work. In Quebec and Montreal there is some fine work; and it is almost universally used as a paving material. In Northern Michigan, at Sault Ste. Marie, the walls of the canal and the locks were built years ago by government engineers in cold weather. The work has to withstand the wearing and chafing of vessels that are passing there constantly, and there is little or no wearing noticeable.

There are buildings in Minneapolis that are built entirely of concrete, some of which have been gutted by fire, but they are in as good shape to-day as when they were built, years ago. There are business blocks where all the wall faces and the ornamental work are of concrete, and it is regarded as a wholly satisfactory substitute for stone and is very extensively used. The same is true of St. Paul, of Milwaukee, Duluth, and other Northern cities, while an almost endless list of cities in the milder sections of the country would each contribute its testimony in the success of concrete for the hardest wear. In Chappaqua, N. Y., a building was built by Horace Greeley more than thirty years ago, and although made of an ordinary kind of concrete, it has stood the test of exposure and is as good to-day as when built. In Buffalo a large apartment house is being constructed entirely of concrete.

In cement stucco also, whether on lath or brick grounds, there is a great amount of evidence in England, Scotland, and on the Continent. In Milton, Mass., some years ago, a residence of one of the Colonial governors was pulled down, but it had existed upwards of a hundred years in good condition, and the stucco was only lime mortar on a lath ground.

There is no evidence of a good concrete weathering badly, provided the material has been properly handled. It is asked why it has not been used more, and the answer is, not that it is not fit to be used, but that it has always been too expensive. However, recent advances and improvements in mixing and manipulation have done a great deal in reducing its cost, until it is now able to compete with even the cheapest constructions. In combination with red brick and terra-cotta charming architectural effects may be secured, while for strength, durability, dryness, and rapidity of construction, it is unrivalled by any other material. Combined in many forms with iron, it may be adapted to numberless uses, in arches, domes, and beams. It is readily thrown into ornamental forms of many varieties, and presents a wholly undeveloped field in architectural effects. It is not a new material, and, with the great amount of evidence of its many qualities at hand, it is safe to predict a far wider and more extended use of concrete than has hitherto been known.

ROSS F. TUCKER.

AT a meeting recently held by English manufacturers of Portland cement an association was formed to prevent the adulteration of cement. In our next issue we shall publish the address of Mr. Robert Bevan (Messrs. Knight, Bevan & Sturge), who acted as chairman of the meeting, also the remarks of some of the other manufacturers.

The following is the call issued for the meeting:—

"2 SUFFOLK LANE, LONDON, E. C.,
26th October, 1894.

"*Dear Sirs*, — We are desired to call your attention to the following circumstances seriously affecting the trade in which you are engaged: —

"It is becoming notorious that several Manufacturers of English Portland Cement are largely adulterating their manufacture by the mixture of Kentish Rag Stone, other stone, furnace or oven ashes, disused or exhausted firebricks, or other inert material, and so bringing disrepute upon the good name English Cement has hitherto borne in comparison for quality with cement of foreign manufacture.

"Such practices are so detrimental to the best interests of the cement trade, both by the discredit which is thereby attached to English manufactures, and the unfair competition in prices thereby rendered possible, that it is now proposed to establish an Association of English Cement Manufacturers for the purpose of dealing with and, if possible, putting a stop to a practice so unprincipled and disreputable, and so calculated to perpetuate an injury to the trade.

"We are instructed to inquire if you would be willing to join an Association of Cement Manufacturers for this purpose, and if so we shall be glad to hear your views on the subject, and to know if you would attend a meeting presently to be convened.

"We are, gentlemen,
"Your obedient servants."

IN an article by Mr. Hartranft, printed in our November number, reference is made in the table showing tests of the different brands of cements to the Whitaker cement. We wish here to call attention to the fact that this is the cement made by the Whitaker Cement Co., and sold under the brand of "Alpha" Portland Cement.

THE MASON CONTRACTOR.

A Department conducted in the interests of the Builder, and the Contractor for Brickwork.

SIDE TALKS WITH THE CONTRACTORS.

IN presenting the following the writer has endeavored to briefly discuss certain subjects of special importance to every practical builder, and in presenting the same he has been most particular to treat only such questions as shall be of especial interest to the modern, advancing man, who is always ready to leave the old ruts and listen to new ideas, although he may not be in harmony with some of the old mossbacks everywhere to be found, who insist in believing that the methods of the Pilgrim Forefathers are good enough for them.

The National Convention of the Bricklayers and Masons' International Union, now in session at New Orleans, La., will, before it adjourns, decide on many questions of great moment to the contractors.

This whole question of difference between the contractor and the men is one of the utmost importance to the industrial interests of the country, and at the same time a difficult matter to settle except by the measure of strength between the parties at interest. Many are apt to deplore the work of the unions, but they seem to be a necessity in the present condition of affairs, and, while in many cases much suffering, loss, and injury have resulted from the strikes occurring under the unions, yet I may note many instances where these unions have resulted in the material advancement of the trades they have represented.

For the last few years, however, the great question in agitation has not been so much the rate of wages as the hours of labor. On the part of all the unions, the reduction of the hours of labor from nine to eight seems to be the point at which they are aiming.

The grounds for advocating this reduction of hours are various. Some advocate it in order to distribute labor among a larger number of individuals, others on the ground that such a change will afford the laboring man better opportunities for mental improvement.

That the eight-hour movement will eventually prevail, I have not the slightest doubt. But to come back to the question of unions. It might be said this is an age of unions, both on the part of labor and the capitalists. Syndicates and corporations may represent our moneyed men, and labor unions our toilers, but both are hurtful or otherwise depending on their leadership, and no one suffers more from bad leaders and counsellors than the rank and file in either case. While it is right and proper for the workman to insist on his fair share of the profits of the enterprise in which he is engaged, yet efforts to reduce hours prematurely or increase wages beyond their worth has only resulted in disaster to the very interests that they seek to benefit.

The same again is likely to prove true where the greed of capital seeks to grind the workman to the earth.

In these days of great enterprises there must be a recognition on either side of the just rights of the other, and with such a recognition the constantly recurring labor troubles would be largely avoided.

WITH HIGH BUILDINGS arises a question of good foundations, especially when they are built alongside old buildings two or three stories high. The greater weight of the new and high building is apt to crack the old building and damage it, and great care should be used in building to prevent the settling of the new building from injuring the adjoining property. Should any damage be done the old building, the proprietor of the new structure will be held responsible, and he in turn will look to the contractor for redress, so I would recommend not only care in the foundation of the new building, but that the adjoining buildings be photographed to a large scale before any work is done on the new building, so that their condition might be on record in the event of a claim for damages. These photographs should be taken under the charge of one well acquainted with the building, and should be not only the back and front, but the side and parts of the buildings adjoining the new one. Often there are cracks in these side walls, and they ought to be photographed. One may laugh at the idea of photographing a crack, but it is sometimes very necessary, and I have seen the owner, who was claiming that the new building had damaged his property, look very queer when a photo of that same crack was shown, proving that it was there before the new building was erected. I have seen photographs introduced in court on a trial in regard to a building contract, and can appreciate the effect on a jury. The photograph can produce indisputable facts, and its possibilities should be borne in mind by contractors.

SCAFFOLD BUILDING is a question that is becoming of great importance in the crowded thoroughfares of a large city. In the first place, a scaffold which is to hold and support a system of staging must, first of all, be of sufficient strength for its purpose; second, occupy the space required for its supports in such a manner as to not impede the progress of pedestrians or the movement of merchandise; and, thirdly, it must be portable, easily put together and taken down, and be removable without injury to its parts. Most of us are familiar with the methods of scaffold building in general use, particularly the wasteful method of splicing timbers together and bracing them with boards, and the universal reliance placed upon the holding power of a nail or spike, and many of us have witnessed the wholesale destruction of lumber which takes place when such scaffolding is removed.

Many of us also are acquainted with the light iron skeleton framework composed of interchangeable members, fastened with collars, screws, or clamps, or other mechanical devices, and it is this type of scaffolding that is needed in large cities rather than that of timber construction, for timber is becoming scarce and its constant renewal is not the only source of expense entailed by it. The storage of large pieces of timber in cities like New York and Boston is growing more burdensome each year; the extra cartage, too, on such bulky materials is another item of importance to be considered, so that, when all of these factors in the cost of scaffolding, including its maintenance, are added together, the sum amounts to so much that new methods and devices have at last been forced upon builders and contractors. In addition to the question of cost is that of the personal safety of the builders themselves. Strange as it may seem, the element of personal safety, either to his men or to himself, seldom enters into the calculations of a contractor, for his business is attended constantly with more or less personal danger, and to a certain extent he has become used to it, and for that reason it is almost needless to urge any consideration of the subject upon that ground. Although there is a vast amount of conservatism in the modern contractor about trying new methods, there is one point upon which he is equally sensitive with other men, viz., upon the question of increased profits, and it is to this phase of the new methods in vogue that his attention is commended.

BRICK BUILDINGS in almost all cities are from time to time disfigured by streaks and patches of white. The evil is most noticeable in dry weather on parts of walls subjected to dampness, and on entire walls after rainstorms have soaked them. The white coating is derived primarily from both the bricks and the mortar. In some instances it undoubtedly comes from the bricks; here the white substance is dissolved by moisture from the bricks even before they are built into the walls, in fact it can sometimes be seen on bricks fresh from the kilns. It has a peculiar taste, that of sulphate of magnesia, but besides this salt the bricks also contain sulphate of lime.

The theory is that the silicates of magnesia and lime in bricks are converted into sulphates by the sulphuric acid evolved from the sulphite of iron and iron pyrites contained in the coal employed in the kilns.

Now sulphate of magnesia effloresces in dry air, and sulphate of lime is dissolved by moisture and appears on the surface of the bricks. Hence, plainly, one mode of preventing the incrustation is the employment of only wood, or of coke free from sulphur, in the kilns; at least this might be done in the manufacture of pressed brick for house fronts.

As for the incrustations having their origin in the mortar comes from the fact that sulphate of magnesia is largely produced by the decomposition of mortar. The observations on this head have special applications to vicinities where most of the lime used in buildings is from magnesia limestone.

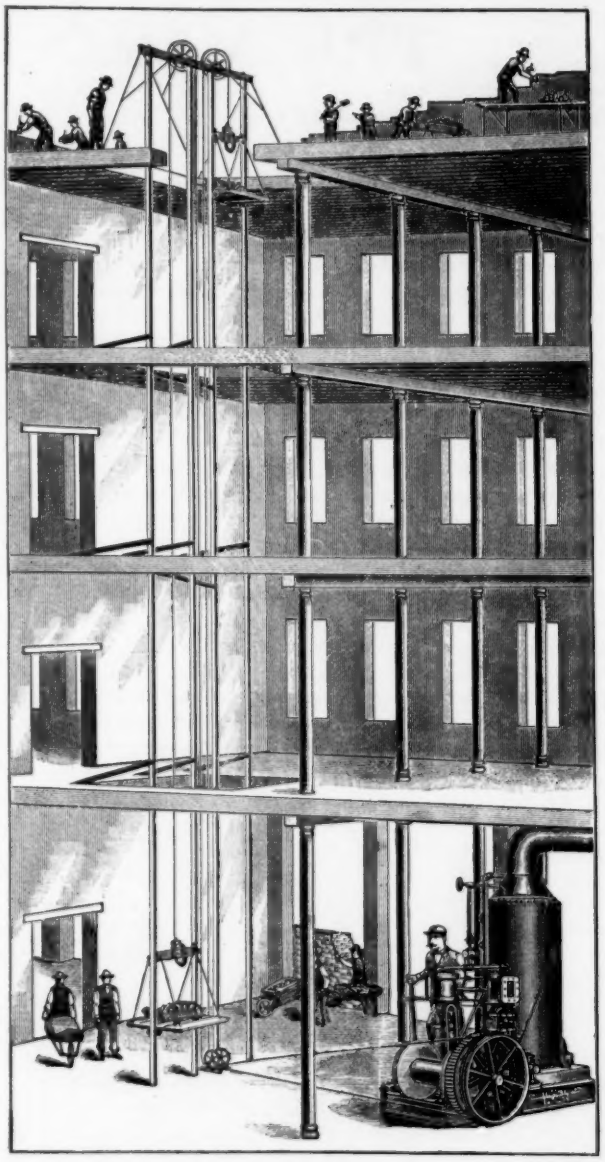
The resulting mixture of limestone and magnesia when slaked and made into mortar is very susceptible to the influence of sulphurous fumes in the atmosphere, which produce in the mortar sulphates of lime and magnesia.

The great solubility of magnesia facilitates its diffusion; sulphate of lime is comparatively insoluble, and does not cause so much disfigurement. Of course mortar made from magnesia limestone quickly decomposes, and the brick it was intended to cement becomes loose. The remedy for this is the employment of lime from non-magnesia limestone. The remedy also offered for this evil is the addition of a small quantity of baryta to the water used for tempering the brick clay. The baryta having a strong affinity for the free acid would seize upon it and with it form insoluble sulphate of baryta. A like addition of baryta to mortar after it is prepared for use may reasonably be expected to check the tendency to efflorescence, except, of course, when the mortar, as in chimneys, is continuously exposed to sulphurous vapors. The white patches may be washed off with simple water, then use linseed oil as a coating, which is an excellent treatment. The best success has been attained when diluted muriatic acid has cleansed the pores in the bricks and thus permitted the oil to penetrate farther into the bricks and keep the wall dry.

DAMPNESS in the walls of large buildings is a constant source of annoyance in many instances and is generally caused by the presence of water in the atmosphere and soil combined with the porosity of building materials which absorb it. Its effects are to cause disintegrating of masonry, the decay of timber, the development of saltpetre on walls, and injury to the health of the inhabitants of the buildings, with damage to the decorations of walls and furniture. Remedies to prevent and cure it may be applied to both the causes by, first, employing suitable materials for cellars and other parts of buildings below or on the level of the soil; second, inserting damp-courses to stop the upward progress of dampness; third, applying preparations to protect the face of the exposed wall from the weather, or to prevent damp in the wall from affecting an apartment; and fourth, adopting precautions against infiltration. Concrete covering the whole ground area of the future building with a layer four inches thick forms the most sanitary foundation. It is usual, in order to keep the walls dry, to have near the ground level a course which is called a "damp-proof course," and for this purpose asphalt may be used, or a double course of slate bedded in Portland cement. The asphalt should be spread about one half inch thick (and sprinkled with coarse sand), and of the best quality, and there may be no fear as to the compressibility of the asphalt of that thickness from the heat of the sun in the summer time on account of the proximity of the soil and the alternation of temperature of day and night. And there can be no question that the construction of masonry below the ground line of buildings should be done in hydraulic cement mortar, as an effectual means of preventing the ascent of humidity in buildings.

Dampness is said to prevail most in buildings finished hastily, because the materials which compose the walls, having never been dry, conform themselves to the humidity rising in a regular current by capillary attraction, never allows the possibility of the walls becoming dry.

R. N. BUELL.



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THE MANUFACTURER.

ENAMELLED BRICK.

THERE is perhaps no one product in general use that so distinctly marks the progress of a nation's growth and wealth as its clay products, in their various forms. Steel is a wonderful factor in the construction of the larger modern buildings, but *its* skeleton has to be clothed with the production of the clay-worker, and for exterior uses (as well as interior) there is no doubt but that enamelled brick will take front rank in the future for this purpose, especially when it becomes known that all the beautiful designs in architecture and harmonious blending of colors are attainable in this class of work, to which is combined durability, beauty, and freshness for all time. While great strides have been made in this country in the manufacture of common and pressed brick, paving brick, terra-cotta, roofing tiles, etc., the enamelled brick industry has not kept pace, and is in its infancy, chiefly on account of the greater difficulties involved in the manufacture of this specialty, so that hitherto most of the needed supply has been imported at large cost from England; but within the past year Chicago has added this industry, in all its completeness, to her former productions, so that the projectors of such structures as the great Marquette and Reliance buildings were able to procure the immense quantity of enamelled brick required for these structures right at home, and no finer enamelled work can be found in this city or elsewhere.

The true enamelled brick is just as good for external as for interior use. They stand the most severe and sudden climatic changes, and may be used in any climate and in any situation.

It is a surprise to any one visiting England to see the variety of purposes for which enamelled bricks are being used in that country. The approaches to their railway stations, exterior of buildings surrounding the platforms, booking offices, waiting-rooms, toilet-rooms, etc., are worked out in patterns and beautiful designs of different colored enamelled bricks. They are used also in the large hotels and stores, post-offices, banking and insurance offices, factories, engine-rooms, cemetery vaults, stable interiors, and also in the underground railways. Enamelled brick have won such favor in England that the municipality of London requires that all courts and alleys be lined of this material. It reflects light, is fireproof, acquires no odor, is impervious to moisture, and forms a finished surface which is highly ornamental.— *Inland Architect and News Record.*

HORTICULTURAL HALL, Philadelphia, Pa., which was destroyed by fire several years ago, will be rebuilt at once, in accordance with the designs of Architects Frank Miles, Day & Bro. The new building will be a very elaborate affair, in the style of the Italian Renaissance, built of brick and terra-cotta with tile roof.

A novel feature of the exterior, which is quite a departure from the usual methods, will be the frieze of the main building. It will be four feet high and about three hundred feet long, modelled in bold relief and treated in color, similar to the work done in the time of Raphael; this frieze will be made of terra-cotta.

The interior will furnish accommodations for the Floral Club and the Horticultural Society; there will also be large rooms for balls and banquets, a hall for lectures, and the required anterooms; the main hall will be elegantly finished in marble and will contain a grand stairway of the same material; the interior finish will be principally of marble and mahogany.

The work will be ready for bids about Feb. 1.

THE name of Akron's new mayor is Erastus R. Harper, and an excellent man has been chosen to fill the vacancy occasioned by the resignation of Lorenzo Dow Watters from that office.

Mr. Harper, who is one of the most prominent and substantial business men in this city, is thirty-seven years old and resides at 108 Franklin Street. He was born in Independence, Ohio, and came to this city fourteen years ago. Since that time he has become prominent in business circles, and has always taken an active part in politics. Mr. Harper is at present identified with many of Akron's business concerns, being secretary and general manager of the Akron Vitrified Pressed Brick Company, a director of the Akron Building and Loan Association, and president of the Citizens' Club. — *Akron Beacon.*

THE beautiful white clay from which the brick of the White Brick and Art Tile Company is made is mined on the site of their plant at Clayton, Mass. The plant is equipped with the Boyd presses and has eight kilns. It is particularly well located for the New York and New England markets, being on the lines of the New York, New Haven and Hartford and the Pennsylvania and Reading roads. This brick was recently specified by Bruce Price for the palatial residence of George Scott, Esq., at Newport.

THE ATWOOD FAIENCE COMPANY have completed their new plant in Hartford, on the line of the New York, New Haven and Hartford Railroad, and have already enough orders to start kilns. The factory is a model one in every respect. Mr. Atwood is well known as having been at the head of the Fiske, Homes & Company Faience department. With his well-known energy and ability, we look to see some of the best results ever obtained in this line of clay art.

PHILADELPHIA, PA. — The Conkling-Armstrong Terra-Cotta Company has been incorporated by Ira L. Conkling, Thomas F. Armstrong, Edward N. Conkling, Samuel O. Conkling, Thomas Armstrong, Albert R. Taylor, William H. Bell. Capital stock, $60,000. A permit has been taken out for the erection of a factory building on Wissahickon Avenue, and the work of erecting will be commenced at once. The main factory will be 60 by 160 feet, and will be two stories high, with a wing 45 by 90 feet.

THE THURMAN FUEL OIL BURNER COMPANY, Indianapolis, Ind., have issued a new catalogue of their burners that should certainly interest any parties who are agitating the question of economical fuel. The pamphlet treats the subject very directly and to the point, and contains a number of strong indorsements from parties who have used the Thurman burner with gratifying results.

THE YALE BRICK COMPANY, of Berlin, Conn., are making a splendid front brick in various colors. Mr. Yale has a system of his own for dampening the fine clay as it is fed to the press, and the results prove his invention to be a success.

THE STEPHENS COMPANY will succeed Stephens, Armstrong & Conkling as the Philadelphia branch of The New York Architectural Terra-Cotta Company.

GALVESTON, TEX. — The American Dry Dock Company, 524 Tremont Street, want bids on 1,500 barrels of best Portland cement.

SALINA, KAN. — The Acme Cement Company have removed to St. Joseph, Mo.

CEDAR GROVE, W. VA. — The Cedar Cliff Cement Company is building a new mill.

MINNEAPOLIS, MINN. — The Minneapolis Cement Company has been incorporated.

RECENTLY INCORPORATED.

Chicago: Rogers, McDonald Pressed Brick Co., $250,000. Samuel W. Bradford, Atlee V. Cole, and Frederick J. Patterson. — Des Moines, Ia.: The Capital Brick and Pipe Co., $100,000. John B. McGorrisk, pres., D. W. Wooden, V.-P., E. H. Conger, Sec. and Treas. — Baltimore, Md.: The Druid Brick Co., $40,000. Nicholas C. Penniman, Wilmer L. Keller, Frank Debelvis, Griffith Cook, and George C. Harding. — St. Louis, Mo.: The Mount Pleasant Brick and Quarry Co., $40,000. H. R. Becker and others. — Milwaukee, Wis.: The Rameses Earthen Ware Co., $150,000. James Douglas, Andrew S. Mitchell, and Thomas K. Ewing. — New Brighton, Pa.: American Porcelain Co., $50,000. Thos. E. Marshall, Frank S. Reader, J. S. Boyd, Thos. Craven, and Sam'l L. Marshall. — Alexandria, La.: The National Terra-Cotta Co., $100,000. David N. Saum and others. — St. Louis, Mo.: The New Haven Pipe Co., $100,000. A. S. and A. E. Speirs, James Smith, and Wentworth Terry. — Oakes, Pa.: The Pennsylvania Enamelled Brick Co., $100,000. — Terre Haute, Ind.: The Terre Haute Mosaic Tile and Marble Co., $10,000. E. J. Norris, Harry Duxler, P. C. Kintz, D. M. Hessler, P. A. Bowsher, M. E. McCan, and J. W. Landman. — Mechanicville, N. Y.: The Best Brick Co., $10,000. A. B. Orcutt, Jones B. Orcutt, Wm. N. Carey, Ezra W. Swartout, and H. E. Barton. — Roaring Branch, Pa.: The Ralston Brick Co., $50,000. — Indianapolis, Ind.: W. G. Wasson & Co., cement and lime. — Phillipsburgh, N. Y.: Phillipsburgh Cement Works, $300,000.

San Antonio, Tex. — The San Antonio Pressed Brick Company has been organized by Jacob Leonardt, of St. Louis, as president, and others, and will erect a plant for the manufacture of pressed brick. Work on the latter will commence at once. The machinery will cost $20,000.

Southampton, N. Y. — The Southampton Brick and Tile Company has been incorporated by William T. Graham, William F. Halsey, William N. Seely, James E. Jennings, and H. M. Howell, of Southampton. Capital stock, $10,000.

Washington, D. C. — The National Terra-Cotta Siding Company has recently been organized to manufacture the new building material known as "terra-cotta siding." The plant has been located, the machinery to manufacture developed and purchased, which is now on its way to this city, and more than half a million feet of engaged sales of its product secured.

Washington, D. C. — The Washington Brick and Terra-Cotta Company have been granted permit for the erection of a brick-burning kiln on Delaware Avenue, between O and P Streets, Southwest. It will be 55 by 55 feet, and built by P. S. Yougren.

Philadelphia, Pa. — Webster, Gillespie & Co., brick manufacturers, have put their plant in operation, with one hundred additional workmen, and are prepared to work every day through the winter that the weather will permit. They report trade to be in a flourishing condition.

SITUATION WANTED.

AN EXPERIENCED MASON FOREMAN wishes a situation as foreman or inspector of mason work. Will work anywhere and is experienced in buildings, railroads, and marine masonry. Refer to the editor of this paper. Address

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THE greatest development in the manufacture of brick has been in the invention of clay-working machinery. — BLAIR.

I FIRMLY believe the successful director of a brick works should travel and become familiar with the different methods of manufacture in different places. — BLAIR.

I AM not sure whether all of you have ever heard of that wonderful finding of a certain grand jury in Tipperary County in Ireland. They had come together in solemn conclave for the good of the whole. It was resolved, first, that they have a new court house; second, that the new court house be built of the materials of the old court house; third, that the old court house should not be torn down until the new one was finished. — REV. MR. TOWNSEND.

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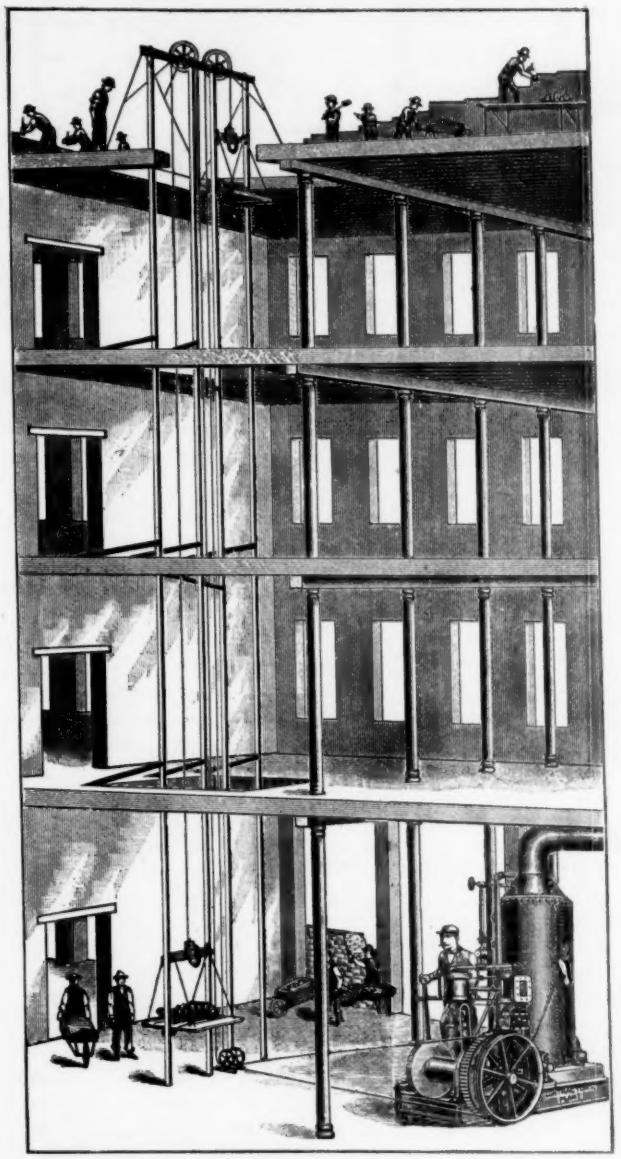
THE qualities which a city street must have to be a profitable investment to its builders are: 1st, durability under the kind of traffic it will have to endure; 2d, smoothness without slipperiness; 3d, good sanitary qualitles; 4th, cheapness. Without discussing at this time the relative merits of brick compared to other forms of paving materials, it is safe to say that it is now accepted as the greatest factor in the streets of this generation. — ORTON.

WE calculate there must now be made about 15,000,000,000 brick annually. The census also shows there was $83,000,000 of capital invested in the business; the value of the product, $67,777,695. It paid in wages $32,833,587 to 109,157 employees. — BLAIR.

WHEN I look around and meet from year to year such friends as I see before me and know what pleasant associations exist, and at each new convention pleasant associations are formed that spread out and help, or that we go from our offices to distant cities in this country and we meet friends and are entertained by these friends, and when they come to our office we have an opportunity to entertain them: those are the pleasantest features that I can refer to when looking backward. — ITTNER.

THROUGHOUT this broad land there is dotted here and there the brick yards of our members, giving employment to armies of men, and from their beds of clay are wrested treasures which, by the deft hands of the men into whose faces it is my privilege to look, have been fashioned those shapes and forms in brick and terra-cotta which delight the eye and minister to the comfort and convenience of our people. You have provided for the people's needs, you have anticipated their demands, you have created conveniences and comforts in the construction of homes and public buildings, and at last, in the closing years of the nineteenth century, you have solved the problem which has taxed the ingenuity and baffled the skill of man from the days of Cæsar to the present time, you have given to the world a material out of which roads may be constructed, which is cheap, easily repaired, which is practically unlimited in endurance under ordinary traffic, and which I confidently believe will be brought up to a standard that will render them more enduring than granite blocks; in every other respect their superiority is universally conceded. — ALSIP.



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